THE LAWS OF LIFE AND HEALTH

The Apollo Belvedere.

THE LAWS OF LIFE AND HEALTH

BY

ALEXANDER BRYCE
M.D. (GLAS.), D.P.H. (CAMB.)

WITH NUMEROUS ILLUSTRATIONS DRAWN FROM LIFE

LONDON: ANDREW MELROSE
3 YORK STREET, COVENT GARDEN
1910

TO

EMERITUS PROFESSOR

JOHN GRAY McKENDRICK

WHO FOR THIRTY YEARS
AS THE INCUMBENT OF THE CHAIR OF PHYSIOLOGY
IN GLASGOW UNIVERSITY, WAS THE INSPIRING
TEACHER OF ALL THAT RELATES TO THE

HEALTH OF THE BODY

TO THOUSANDS OF MEDICAL MEN NOW SCATTERED
ALL OVER THE WORLD, THIS BOOK IS RESPECTFULLY
AND BY PERMISSION

DEDICATED

BY HIS OLD PUPIL AND ASSISTANT
THE AUTHOR

PREFACE

THIS book is written primarily for all who are interested in the preservation of health. It is as free from technical terms as is possible in discussing a scientific subject, and where such terms have been found necessary they have been carefully explained in the simplest language at my command.

At the beginning of most of the chapters the physiology of the parts involved has been described somewhat minutely. For this reason I hope that the volume may commend itself likewise to teachers of personal hygiene and to the student of medicine whether in practice or not. The subject of personal hygiene has not yet been included in the medical curriculum, but the public is calling out for information which has been in many cases somewhat inadequately supplied by amateurs. I shall be well repaid for the labour involved in writing this book should my medical brethren consider that it enables them to give some authoritative reply to many of the questions propounded by their patients.

Recently a large number of books of a similar character has emanated from members of the medical profession, but I make no apology for adding to the list, as ignorance of the best means of caring for the body is still widespread. The precepts inculcated are in the main

the outcome of practical experience, although I have doubtless incorporated in the text many facts obtained in the course of my reading. The following among other books have been of much value to me in the preparation of this volume:—Landois and Stirling's "Physiology," M'Kendrick's "Physiology"; "Applied Physiology" (Hutchison); "The Body at Work" (Hill); "The Care of the Body" (Cavanagh); "Further Advances in Physiology" (Leonard Hill); "Drugs and the Drug Habit" (Sainsbury); "Health and Common Sense" (Woods Hutchinson); "Alcohol and the Human Body" (Horsley and Sturge); "Personal Hygiene" (Pyle); "Functional Nerve Diseases" (Schofield); "Ideal Health" ("M.D."); "A System of Physiologic Therapeutics" (Cohen); "A System of Practical Therapeutics" (Hare); "Minor Maladies" (Williams); "Essay on the Prolongation of Life" (Weber); "Influence of the Mind upon the Body" (Tuke); "Physiological Economy in Nutrition" (Chittenden).

I am especially indebted to Professor Russel H. Chittenden for revising Chapter X., and to Dr. J. T. Case for revising Chapter I.

ALEXANDER BRYCE.

MOSELEY, BIRMINGHAM.

CONTENTS

CHAPTER IV.

Work.

CHAPTER V.

Rest.

CHAPTER VI.

Air.

CHAPTER VII.

Exercise.

CHAPTER XI.

Cheerfulness.

ILLUSTRATIONS

INTRODUCTION

THE purpose of this book is to set forth in plain language the laws of health. This is not so simple as at first sight it may appear, because, although these laws are as inviolable as the laws of the Medes and Persians, they are not nearly so definite: they vary in their application to each individual, according to temperament, environment, and type of constitution.

Before, however, venturing on this task it will be necessary to make an effort to define health itself, and this is still less easy, because no accurate definition of health has ever been formulated. What is Health?

Health is not an absolute, but only a relative condition, and it has no necessary relation to strength of body. It is quite possible for a man to be in the best of health and yet to be what is termed a weakling; and, conversely, it is by no means unusual to find the most highly developed specimens of humanity suffering from maladies due to the straining of internal organs owing to the excessive cultivation of muscular power.

It is seldom, indeed, that one finds the herculean type of humanity without some discomfort amounting to disease —which is really only "lack of ease,"—and it is well to realise that after all the healthy man is the man who can resist disease. In order that the seeds of disease should develop in the human frame it is quite as essential to

prepare the soil as it is in a garden; and in both cases unwelcome seeds will grow by neglect as freely as those most desired. Health is that condition of the body which prevents the growth of pathogenic micro-organisms, and in its simplest aspect is exemption from disease. But as this negative point of view is not as a rule satisfactory it will be wise for a moment to consider the matter on its positive side and to inquire what are the signs of health.

The Power of Adjustment.

A healthy organism is one which can adapt itself—and go on adapting itself—both in structure and function, to its surroundings; and of all organised beings man displays the greatest ability to adjust himself to his environment. The human family has the power to remain in perfect health in the coldest of Arctic regions and in the hottest of tropical zones; the highest of mountains and the lowest of valleys are compatible with health within limits.

This implies that a healthy frame is one which has a good construction, capacity for endurance, self-control (not only physical but mental and emotional), and ability to resist all sorts of injurious influences. The actual signs, however, of this condition are so illusory and so liable to misinterpretation that it is wise to fall back upon a more general definition, and probably the best is, that health is the harmonious adaptation of the body to its environment.

This fulfils every requirement, and is in accordance with the Spencerian doctrine that life is the continual adjustment of inner relations to outer relations. Health and disease are different aspects of the same body, definite results flowing from definite conduct, just as good and evil in the moral world have the same physical substratum and one or the other will arise according to the actions of the individual.

It will be obvious from this description that the laws of health are by no means stereotyped, but are simply principles of action for the guidance of the individual. Huxley said that "the laws of Nature" were not causes but simply a name for an observed succession of facts, and so the laws of health may be said to be rules of action governing our conduct, deduced from the experience of centuries, attention to which brings about such a condition of body as will enable us in comfort and happiness to pursue our business and social demands for the longest possible period of time.

The Laws of Nature.

Manifestly, disease of all kinds and of every degree of severity must have been due in its initial stages to violations of the laws of health by the victim of the disease or his immediate or remote ancestors; and so long as the violation of the law continues there can be no hope of remedial measures having anything but a temporary value. Nature takes no account of the fact that we have not been aware of the laws which we have broken. So soon, however, as the deviation from the paths of physiological rectitude ceases, the *vis medicatrix naturæ* begins its healing effect. Disease, indeed, is Nature's process for the elimination of those who are mentally or physically unable or unwilling to obey her voice, and in this rude way she purges the race of the unfit and strengthens the species by making the fittest survive.

Health is Nature's reward for getting into harmony with her laws, and thus it is only necessary to put one's self into line with Nature to reap all the advantages of her undoubtedly beneficent designs.

As nature, however, does not lay herself out specifically to teach her laws, but leaves us to find them out for ourselves by a peculiarly painful process, and as we may fail to learn them effectually before much irreparable

The True End of Medicine.

damage has been wrought in our bodies, it is of prime importance that they should be classified and rendered easy of access to all who are interested in conserving their health.

I hope that this attempt to codify these laws may, by its comparative fulness and practical illustration of the facts of physiology, appeal to the student of medicine, besides serving, by reason of its simple language and lack of abstruse terminology, as a guide to the public in all questions of personal health. Sir Rupert Boyce, the well-known leader of the scientific investigation of tropical diseases, declared himself the other day an enthusiastic believer in the ability of a nation in whatever clime to keep itself free from disease by fulfilling the two following conditions:—

(1) That the teachings and directions of the expert, the man of science, should be implicitly obeyed and carried out.

(2) That the community individually and collectively should organise and co-operate to fight disease.

These words were meant to apply specially to infectious disease, but they may usefully be extended to the consideration of disease in general, and, as "Prevention is ever better than cure," to that still higher ideal, the maintenance of health.

In presenting the following decalogue of health, which is more than a compendium of the best features of the work of many predecessors, I hope that I have combined reasonable brevity with definiteness and accuracy of statement, both so essential in the treatment of such a subject.

A thoughtful perusal of the book and the careful practice of its precepts must be followed by an improvement in the health of even the most weakly. An aged

Scot told his minister that he was about to make a pilgrimage to the Holy Land. "And when I'm there," said the pilgrim complacently, "I'll read the Ten Commandments aloud frae the tap o' Mount Sinai." The minister looked at him with an eye of pity, and said, "Sandy, tak' my advice: Bide at hame and keep them."

The hint conveyed in this little anecdote is worthy of being taken to heart by all who read this volume.

THE LAWS OF LIFE AND HEALTH

CHAPTER I.

FOOD (GENERAL).

LAW I.—"Eat three meals each day of plain, wholesome, solid, nourishing food, at or about the same time as far as possible."

The Balance of the Body.

A SUCCINCT and comprehensive definition of food is not possible, but the following probably fulfils all requirements: "Any substance which, when introduced into the living organism, will build up and repair the waste of its tissues, and furnish it with heat and energy." Perhaps it might be wise to add that this should be accomplished without causing injury to any of its parts, or loss of functional activity. The difficulty experienced in constructing such a definition is in some degree a measure of the controversy which has raged, and still rages, round the subject.

The human body contains the following chemical elements:—nitrogen, oxygen, carbon, hydrogen, sulphur,

phosphorus, chlorine, iodine, sodium, potassium, calcium, magnesium, iron. These are constantly present in the body, and there are occasionally some others. It is evident that, for the growth of the body and the repair of its wasting, all these elements must be supplied in the shape of food.

Human beings, however, cannot feed upon chemical elements, and so they have to fall back upon organic substances containing them. The origin of these organic substances is of great interest. The ultimate non-vital chemical elements and their compounds which reside in the air and in the soil are absorbed by plants, which elaborate them into vital organised tissues. These, as cereals, fruits, and vegetables, are now capable of being converted into food by animals and human beings. The flesh of animals which live upon such plants, being well flavoured, is eaten by man, and is really a short cut to the nutriment contained in the plants—at least to the protein nutriment. All organised life—plants, animals, and man—ultimately loses its vitality and is converted anew into its constituent non-vital elements.

It is found by experience that all food necessary for man may be grouped under five heads or proximate alimentary principles.

(1) *Proteins.*—These form an essential part of all muscles, nerves, glands, and indeed all living cells. The most ready form, therefore, in which they may be obtained is the flesh, *i.e.* the muscular portions, of a dead animal, although they exist as gluten of wheat, casein of milk and cheese, legumin of peas, beans, lentils, and albumin of eggs and nuts. In whatever form they exist, however, they have practically an identical composition, and within certain limits can replace each other in

nutrition. They are almost entirely absent from fruits, and present only in minute proportions in vegetables.

The essential element in this division is nitrogen, which is to be found in none of the other alimentary principles. Gelatine, which contains a larger proportion of nitrogen, is allied to proteins, but cannot fulfil the same functions. It prevents, however, the rapid burning-up of protein, and on that account is termed a "protein-sparer." The functions of this class of nutrients are: (1) To repair and maintain the tissues and secretions of the body; (2) to stimulate functional activity; (3) in some small measure to furnish heat and energy or the laying down of fat, since they can be split up into a nitrogenous and a non-nitrogenous portion.

(2) *Fats or Hydrocarbons.*—These comprise the various animal and vegetable fats, oils and wax. They are composed of carbon, hydrogen, and oxygen, and vary in their physical state, their digestibility, and hence in their value as foods. Hot mutton fat is perhaps the least digestible, just as butter, especially when spread on bread, is the most digestible. Fats abound in certain foods, *e.g.* nuts, the olive, the pea-nut, and the soya bean of Japan. Maize contains 5 per cent., and oats about 7½ per cent. of fat. Animal foods of all kinds contain a proportion of it, *e.g.* milk and butter, cream and cheese, yolk of eggs, bacon, cod liver oil, etc.

Fats act (1) as protein sparers, (2) as a source of heat and energy, (3) by being deposited as adipose tissue, they act as reserve stores of force-producing and heat-generating material.

(3) *Starchy and Sugary Substances.*—These are grouped under the general term of carbohydrates. They are composed of carbon, hydrogen, and oxygen, the last

two being always present in the same proportions as they are in water. They are the most abundant of the food elements, and comprise four groups:—

(1) *Starches.*—These are found in grains and seeds and nearly all vegetable substances. Starch is also found in green, but not in ripe, fruit, and, with a few exceptions, is not found in nuts. More than half the weight of most grains consists of starch, and it is possible to tell the source of starch granules from their particular shape.

(2) *Sugars.*—These may be (*a*) cane sugars found in the sugar cane; (*b*) lævulose, or fruit sugar; (*c*) glucose, prepared by heating starch with sulphuric acid—a most inefficient substitute for vegetable sugars; (*d*) lactose or milk sugar; (*e*) maltose or malt sugar.

(3) *Dextrin.*—This is practically soluble starch.

(4) *Cellulose.*—Insoluble and, for the most part, indigestible starch.

Starch is converted into dextrin by cooking, and this again by the saliva into maltose. Uncooked starch cannot be acted upon by the saliva, but passes into the stomach, where it interferes with the process of gastric digestion. It is only digested when it reaches the pancreatic fluid in the small intestine.

Carbohydrates are rapidly burned up in the tissues, and rapidly produce heat and energy.

(4) *Mineral Substances or Salts.*—These are chiefly:—

(1) Phosphates, chlorides and carbonates of lime, sodium and potassium, which exist in most of the commonly eaten foods.

(2) Tartrates, citrates, and malates, to be found in fruits and easily convertible into carbonates in the body.

(3) Iron, in prunes, yolk of eggs, meat, spinach, etc.

(5) *Water.*—This constitutes three-fifths of the body, for not only are the cells composed chiefly of water, but they are surrounded by it more or less freely.

These five alimentary principles are to be found in the food of every individual in the world, however the component parts of his diet may vary in form and appearance, and even the proportions in which they are consumed agree to a large extent in the most diverse dietaries. This statement requires modification so far as the arctic and torrid zones are concerned, for in the former a larger proportion of fat and protein and in the latter a preponderance of carbohydrate material is consumed. Influences on Diet.

Quite two-thirds of the inhabitants of this globe subsist on a vegetarian, or what is commonly called a fleshless diet, and a nation is committed to a particular style of food, not so much from the point of view of nutrition as from religious or social motives or climatic necessity. Most people find their dietetic habits settled for them before they arrive at the reflective period of life, and many emulate the old gentleman whose rule of life was, to eat and drink what he most fancied and then go to bed and "leave them to fight it out as best they could amongst themselves." Doubtless, temperament has much to do with the food we eat, and idiosyncrasy plays a greater part than one would imagine.

Too much thinking of an analytical kind about food is probably dangerous for most of us, and perhaps this is the tendency nowadays when so much hygiene is being taught. Exact information on such a subject is most

essential, in order that erroneous ideas may be dispelled. Sir Andrew Clarke used to tell the story of an old lady who brought her daughter to consult him. She was suffering from anæmia and gastric ulcer, and he prescribed claret amongst other things. Six weeks later she returned looking plump and rosy-cheeked. Sir Andrew said, "She is much better. I am glad she has followed my instructions." "Oh yes," said the mother, "I gave her plenty of them. We boiled them, stewed them, mashed them, and gave them with all her food, till the house smelt of nothing but carrots." Happily no harm resulted, but the victims of misconception may not always be so fortunate.

The Digestive Organs.

The Organs of Digestion consist of the alimentary canal, salivary glands, pancreas, and liver. In the chapter on "Cleanliness," details are given of the teeth, of which there are, or should be, thirty-two.

There are three salivary glands on either side. The largest is the parotid, just in front of the ear, and is familiar as being usually enlarged in the disease called "mumps." Its duct pierces the mucous membrane of the cheek opposite the second molar tooth of the upper jaw. The submaxillary and sublingual salivary glands have a common duct, which enters the mouth on the under surface of the anterior portion of the tongue.

The roof of the mouth ends behind in the soft palate, which splits into two folds with the tonsil—which should not be seen, unless enlarged or inflamed—between them. After passing the posterior folds or "pillars of the fauces" just mentioned, we enter the pharynx or throat. It hangs as a bag from the base of the skull, and is 4½ inches long, being enclosed by three thin muscles which overlap from below upwards. Above the soft palate,

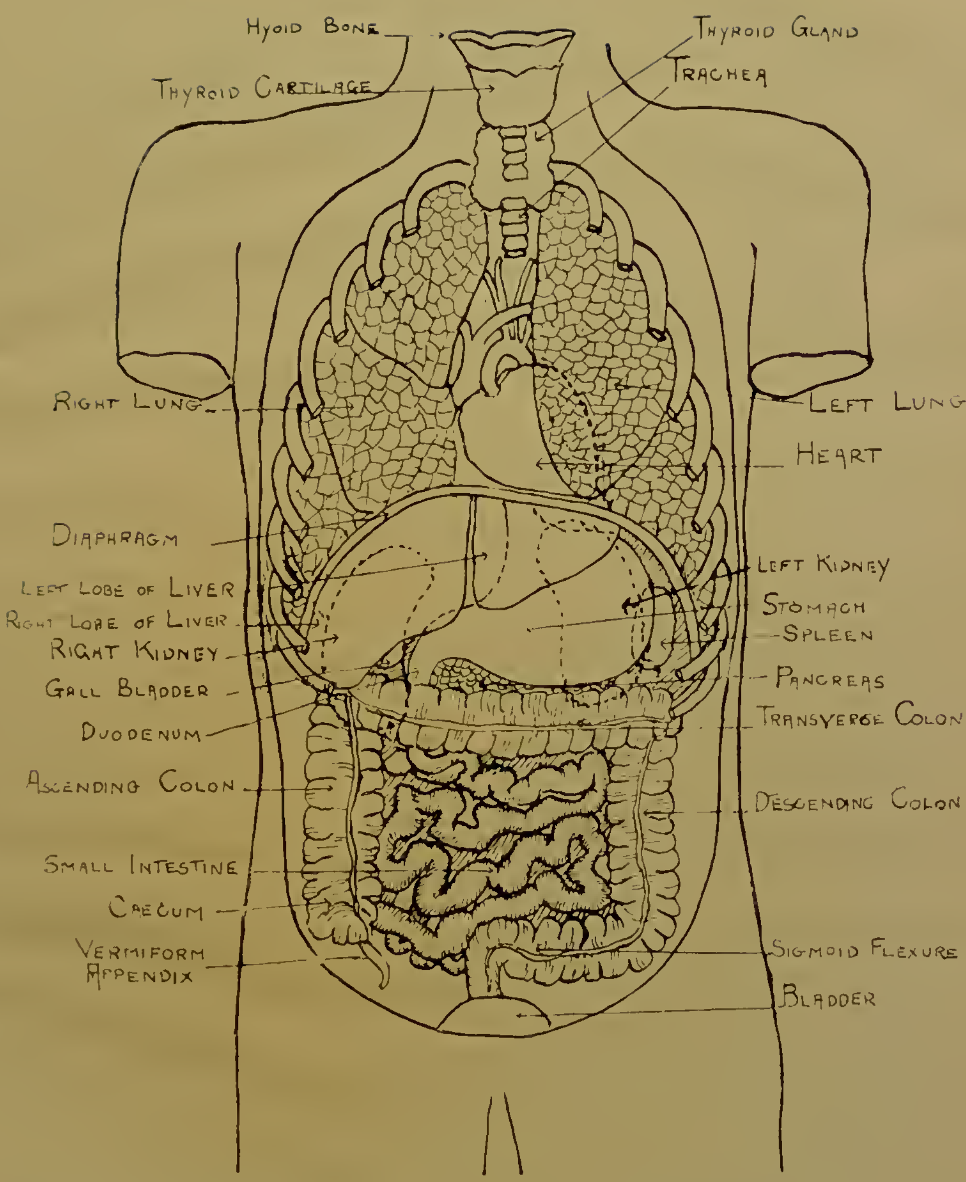


Diagram of the Internal Organs of the Body.—The anterior half of the diaphragm has been cut away and the front portions of the upper ten ribs removed. The dotted lines signify deeply placed organs.

the nasal chambers communicate with the pharynx by the posterior nares.

The pharynx is continued into the œsophagus or gullet, whose length is about 9 inches. It traverses the chest, lying behind the heart, pierces the diaphragm and, just beneath it, joins the stomach.

The stomach is a sickle-shaped bag which has two openings—the cardiac orifice, or the junction with the œsophagus, and the pyloric orifice, or junction with the small intestine. The position of the cardiac orifice is a point 1 inch below and 1 inch to the left side of the lower end of the breast-bone, and from this the stomach extends to a point about 4 inches below the end of the breast-bone and an inch or two to the right side of the middle line of the body—the position of the pyloric orifice. These points should be joined with a small curve for the upper border, and a large curve first up to the left nipple and sweeping boldly to the right for the lower border.

The capacity of the stomach varies, but in the case of liquids is from 2 to 4 pints or even more, whilst it may hold 2 lb. of solid food. Its inlet and outlet are guarded by strong rings of muscular fibres.

The small intestine stretches from the pylorus for about 24 feet to the right groin, where it ends in the colon. Its average diameter is about 1½ inch. Its first part, the duodenum, is 9 inches long, is shaped like a horse-shoe, and has the ducts of the liver and pancreas opening into its descending portion. The remainder of the small intestine is called at its upper part the jejunum, and at its lower part the ileum.

The colon or the large intestine has a length of about 5 feet. It ascends on the right side to just below the liver, then courses across the abdomen towards the left

side under the spleen, then passes down the left side to the rectum. The lowest part of the ascending colon is termed the cæcum, and from it passes the remains of a much larger piece of bowel, which in process of evolution has become atrophied till it is only $3\frac{1}{2}$ inches long. This is the notorious vermiform appendix. The colon is about 3 inches wide, but becomes much narrower at the lower end of the descending part or sigmoid flexure, which terminates in the rectum.

The Dissolution of Food.

The chief object of this lengthened tube from the mouth downwards is that the food may be digested or prepared for absorption into the blood. With the exception of water, all the alimentary principles are insoluble in the ordinary sense, and the process of digestion is simply an extremely elaborate method of dissolving them. This is accomplished by various secretions poured forth at definite points in the alimentary canal.

The Saliva.

The first of these fluids, and probably the most important, because it is the only one under our direct control, is the saliva, the combined product of the three pairs of salivary glands. It is a thin watery alkaline solution, containing only $\frac{1}{2}$ per cent. of solid substance—mainly mucin, ptyalin, and certain salts, of which the chief are phosphate and chloride of sodium. It has three definite functions: (1) mechanical, to moisten the dry food; (2) chemical, to digest cooked starch; (3) to keep the mouth and tongue moist enough to facilitate articulate speech. If a little warm starch mucilage, *e.g.* boiled arrowroot, be divided into two portions, one of which is held in the mouth for about half a minute and then tested by adding iodine water, it will be found that the portion which has been held in the mouth fails to turn blue, showing that it now

contains no starch. The ptyalin in the saliva has converted the starch into dextrin and maltose, the same form of sugar as appears during the malting of barley. The action is much retarded by acids, and hence acid wines should not be taken with starchy foods. Tannin likewise prevents the change, and this accounts for the frequent dyspepsia experienced after tea and cake or bread and butter.

We know how the mere sight or smell or even thought of savoury food causes our mouths to water, and this demonstrates the psychical influence over the secretion. It is an interesting fact that the amount of the secretion from the various glands varies greatly according to the nature of the food. Thus very dry, acid, irritating substances, or a mouthful of sand will provoke an intense flow of watery saliva, Nature's response to prevent injury to the mouth and clear out, if necessary, the intrusive material. When meat is offered to a dog, an abundant flow of saliva comes from the gland under the jaw; when it is offered bread, thin parotid saliva is secreted. The moment the animal realises that it is being cheated, *i.e.* the food first offered being withdrawn, the flow at once ceases. The chief flow takes place when agreeable food is carefully masticated, and the process of conversion of the starch into sugar goes on in the stomach for half an hour after it is swallowed. If mastication of food be confined to one side of the mouth, three times as much saliva is secreted on that side than on the other.

It is to be noted that the saliva is secreted under two impulses: (1) mental stimulus, (2) local stimulus, caused by the disintegration of the food in the mouth under the influence of effective mastication. It will be subsequently pointed out that gastric juice is secreted in precisely the

same way, there being a short initial flow caused by the thought, sight, and smell of food, and a much longer and more continuous flow induced by the presence of food in the stomach. But not all foods excite this latter flow, *e.g.* white of egg, starch, or bread does not cause it, nor does irritation with the finger, or a foreign body like sand. On the other hand, the production of salivary digestion has a great influence in calling forth this secretion of gastric juice, and hence mastication and insalivation have an immensely beneficial influence on the whole process of digestion.

Efficient Mastication.

This fact has been put to the test of experience by Mr. Horace Fletcher, an American layman of independent means. Some six or seven years ago, being the victim of severe indigestion and obesity sufficiently great to interfere with his comfort, and to cause him to be refused for life assurance, he instituted a series of experiments upon specially prolonged mastication, with the most remarkable results. In the first place, he lost his dyspepsia and excess of fat, and increased his health and strength in a notable degree. In the second place, he found that the amount of food which he consumed was enormously lessened, being hardly one-half of what he previously consumed, and in particular that his protein food was reduced to nearly one-third of the amount which had been held to be the minimum. To put the matter beyond the region of doubt, he willingly submitted himself to the careful observation of the late Professor Michael Foster, at Cambridge, who fully verified the results. Subsequently, Professor Chittenden of Yale subjected him to further tests, both in nutrition and muscular strength, with a like result. For quite seven years now Mr. Fletcher has continued his practice, and after the initial loss of excessive fat his body

weight has remained unaltered and his strength has increased.

There can be no doubt as to the good effects of the extremely careful mastication practised by Mr. Fletcher, which may be explained as much by the diminished loss of energy in digestion and excretion as by the perfect utilisation of the ingested food. The late Sir Andrew Clarke used to say that, as there were thirty-two teeth, thirty-two bites should be given to each mouthful before swallowing it; but Mr. Fletcher does not limit his number to this, but goes on chewing until all the taste has been extracted from his food, and then rejects the fibrous, insoluble, and tasteless remainder before swallowing. It is not every one who could or would persevere in what may be looked upon, from the social point of view at all events, as a most inconvenient practice, especially when one considers that soups, milk, wines, water, and indeed all other liquids are submitted to the same process and test before swallowing.

The Importance of Mastication.

Thorough mastication is of infinite value, not only because it brings about complete subdivision of the food into particles minute enough to be easily dissolved by the various digestive fluids, but because it is now conceded that the greater the amount of effective saliva which is secreted, the greater will be the proportion of gastric juice. It is further known that the larger the quantity of gastric juice the greater will be the quantity of pancreatic fluid, bile and intestinal secretions. Effective mastication and insalivation, therefore, are responsible for the completeness of digestion all through the alimentary tract, and, as they are completely under the control, the victim of dyspepsia who knows of this fact must blame no one but himself for the persistence of his sufferings.

In recent years many other experiments confirming those of Mr. Fletcher have been conducted. At Yale University, four years ago, a band of nine students undertook an experiment to test the virtues of thorough mastication without extending it so far as to reject any of the insoluble or tasteless residue. The rules which the men followed were two:—

(1) To masticate thoroughly every morsel of food, with the attention concentrated upon its taste and enjoyment and not upon the mastication itself.

(2) To follow absolutely and implicitly the dictates of the appetite both as to the amount and kinds of food chosen.

The experiment lasted five months, and during this period the men almost doubled their physical endurance as shown by tests made in the gymnasium. At the same time, they adopted unconsciously a simpler diet, with a greatly diminished proportion of meat and eggs. In this and subsequent experiments at Yale and Brussels it was found that the closer the approach was made to vegetarianism, the greater was the endurance; whilst, without having any more strength, the vegetarians had by far the greatest endurance of all.

There are probably many factors to be taken into consideration in the interpretation of these noteworthy results, but my sole object in giving them such prominence is to emphasise the vast importance of mastication. There is ample evidence to show that insufficient mastication in the young is a great factor in the causation of mouth, throat, and nose disease, whilst early decay of the teeth is undoubtedly due to the same cause.

The saliva remains active in the stomach for thirty

or forty minutes—until, indeed, the gastric juice has been secreted in sufficient quantity to render the stomach contents acid. All acids have a tendency to destroy the action of the saliva, some of them even in such a small proportion as one part in six thousand. It is therefore unwise to take vinegar with starchy foods, or to eat oranges, lemons, limes, sour apples, and even grapes at the same meal as bread, cake, and pudding. Fats, when mingled with starch in the form of oils, also interfere with the action of the saliva, hence muffins, hot buttered toast, and pikelets are most indigestible.

Swallowing is not the instantaneous process it appears to be, although fluids and well masticated solids pass down the œsophagus with great rapidity. A "lightning lunch" is almost sure to be followed by some discomfort or pressure in the chest, because the insufficiently chewed lumps of food travel slowly down and make a momentary stoppage at the inlet of the stomach. Even fluids halt here for a little, and their trickling into the midst of the stomach contents may often be heard.

The Functions of the Stomach.

Valuable as the stomach may be to its possessor, it is by no means an absolute necessity, as it has been frequently excised without apparently much harm to the welfare of the body. It is, however, by no means superfluous, as it subserves several important functions. It warms or cools the food, sterilises it and prepares it for propulsion into the bowel, by dissolving its protein contents. This it does chiefly by the secretion of the gastric juice, which is a highly acid fluid due to the presence of hydrochloric acid, and contains two ferments, pepsin and rennin. The former dissolves proteins (and in this respect the gastric juice is so powerful that it

has been said that it can digest its own weight of coagulated egg), the latter curdles milk.

From eight to nine or more pints of gastric juice are secreted in a day, and, in addition to this, the stomach is expected to deal with two pints of saliva and any beverage which may be swallowed by its owner. Before even the food reaches the stomach, gastric juice begins to pour into it—proving that it does not require to be provoked by mechanical stimulation, such as the contact of food. Irritation of the lining membrane by the finger or a foreign body is certainly followed by a secretion, but it is simply that of alkaline mucus to protect the delicate surface.

The mere sight or smell of food and its pleasant flavour in the mouth suffice to induce an outflow of gastric juice into the empty stomach, and this is the psychic or "appetite" juice associated with the name of Pawlow. The mere mechanical act of chewing, or the chewing of an indifferent substance like indiarubber, is not followed by a flow of "appetite" juice. It is necessary to have some agreeable food or the anticipation of it. Hence the importance of preserving the amenities of the dining-hour, providing agreeable company and thoughts, as well as food, and the advisability of carefully attending to the practice of mastication.

It may be noted in passing that appetite and hunger are by no means synonymous, the latter signifying the call of the body for food, whilst the former is apparently derived from some local gastric sensation.

The Internal Juices.

The first function of the gastric juice, or at any rate of its acid content, is to neutralise the alkaline saliva which has been swallowed with the food and is accumulated in the fundus or left-hand portion of the stomach. It may be as well to state here that the

stomach is divided into two portions by a narrow constricting band, the left hand portion—about four-fifths of the whole, being practically a reservoir which slowly contracts upon its contents and gradually drives them forward to the smaller or pyloric portion. In this latter part a continuous series of waves of contraction is taking place, causing a thorough admixture of the food with the gastric juice and a final expulsion into the duodenum. No hydrochloric acid is secreted in the pyloric portion of the stomach, but only in the fundus. In half an hour or so it completely neutralises the alkaline saliva, thus stopping the further digestion of starch at this stage.

Meantime the outflow of "appetite" juice has ceased, and a fresh process is in operation for the continued secretion of gastric juice. This is originated by the action of certain constituents of the food upon the stomach wall, the more powerful of which are a decoction of meat or soup—dextrins, milk and water. These substances are called peptogens, and the addition of these has been found to increase the digestive activity of the stomach as much as twenty-five times. The most important peptogens are those formed from the action of the saliva on the starchy food and the action of the appetite juice on the protein food, and demonstrates the immense value of mastication and agreeable food and surroundings in the production of a good digestion. It also shows how important a little good soup may be at the beginning of a meal, even although thereby some purins may be introduced into the system.

Large quantities of fat, as also alkalis, tend to diminish the secretion of this chemical juice. The composition of the psychical or "appetite" juice is always the same whatever the previous food may be,

but that of the chemical juice is modified to suit the character of the food, bread exciting the most concentrated juice, meat the most acid juice, and milk the least of all.

When all the protein food has been dissolved and chemically combined with the gastric juice—and this should take place in an hour or so—then free hydrochloric acid begins to appear, and this is the signal for some of the contents of the stomach to pass into the duodenum. This takes place by contractions passing along from the fundus to the pylorus about every twenty seconds, and an answering return wave shorter in character assists in thorough admixture. When the food has been finally dissolved it is pushed into the duodenum, although at the end of digestion the pylorus relaxes to allow the passage of even solid indigestible morsels of food.

Such is a brief description of gastric digestion, and, complete though it is, it does not apparently solve an anomaly noticeable in our daily feeding. The question whether carbohydrate food or proteid food should be eaten first is answered by the former method being preferred at breakfast and the latter at dinner. When proteins are eaten first and carbohydrates later, the former occupy the pyloric end of the stomach and the latter lie in the fundus or cardiac end. This causes a slow discharge of the carbohydrates, which must therefore wait until the proteins have been expelled. But there is no great loss after all, because the saliva for at least thirty minutes and probably longer continues to convert the starch into maltose and dextrose. Still, if the carbohydrate had been swallowed at the early part of the meal, it would have been digested and quickly removed from the stomach for further change

in the bowel, leaving the protein in full possession of the gastric juice. Probably both methods have their value, and in any case the stomach seems to be able to accommodate itself to either condition of affairs.

It is erroneous to think that the stomach wall is capable of any great degree of absorption, as only alcohol, sugar, and salts and a little peptone (some say as much as 20 per cent.) can be removed in this way. The feeling of satisfaction and even strength which occurs often after the first mouthful of food is swallowed must evidently be explained by reflex action.

The gases which accumulate and are so frequently eructated from the stomach are mostly swallowed, although some hold that they are secreted into the stomach from the blood.

The Pancreas and the Liver.

The semi-digested food, or chyme, which leaves the stomach in small spurts for the first hour or two, attains its maximum rate of outflow in the third hour. At the same time two fluids, namely, the pancreatic juice and the bile—the former the product of the pancreas, a gland lying behind the stomach, and the latter of the liver, which lies under the right ribs—attain their maximum rate of secretion and mingle with the chyme. So long as the chyme remains highly acid, peptic digestion goes on even in the duodenum, but the strongly alkaline pancreatic fluid quickly neutralises the hydrochloric acid and the intestinal digestion begins.

The mechanism whereby the pancreatic juice and bile are called forth at the psychological moment is extremely interesting. When the acid chyme comes into contact with the lining membrane of the duodenum a substance called "secretin" is formed from the pro-secretin within its cells. This is absorbed into the blood—being one of a great class of agencies called "internal secretions"

—and stimulates the pancreas and liver to secrete their respective digestive fluids. The pancreatic is the most powerful digestive juice known, and contains three ferments: (1) trypsinogen, for digesting proteins; (2) amylase, for converting carbohydrates into maltose or sugar; (3) lipase, for splitting up fats. Trypsinogen itself is, fortunately, inactive till it comes into contact with a ferment in the intestine called enterokinase, where trypsin, the active agency, is found. Were it otherwise, the pancreas itself would stand a very good chance of being digested.

The bile is both a secretion and an excretion. In its former capacity it has a feeble tendency to digest starch. Its other function is fulfilled by the bile salts which precipitate the chyme on the projecting folds of the mucous membrane of the small intestine, and so it is more easily attacked by the pancreatic juice. Bile also converts fats into soluble soaps (which are only compounds of fat and an alkali) and glycerine, in which form they are easily absorbed. It greatly aids the work of the pancreatic juice, doubling its power of dissolving proteins, and trebling its fat-splitting function. It also assists in carrying off two very important waste matters—cholesterin and lecithin—which greatly impede the activity of the nervous system.

The Small Intestine.

The enteric juice is secreted from the whole surface of the bowel right down to within a few inches of the anus. Besides the highly important enterokinase, it contains erepsin, which finally disposes of the proteins—the only waste matter left being a fatty acid called leucin and an aromatic acid called tyrosin. It likewise contains a ferment which converts cane sugar into a mixture of dextrose and lævulose, and completely changes maltose into dextrose, and also inverts milk sugar.

In this highly complex though extremely efficient manner the insoluble food is converted into a series of soluble substances, which are absorbed into the blood through the bowel wall. The process is hastened by means of the intestinal movements, which are of two kinds: (1) an undulatory swaying motion, intended to mix the contents of the bowel; (2) peristalsis, which is a slow vermicular movement for squeezing forward the contents. These are much more intense during hunger, when the normal rate of 1 inch per minute is greatly increased.

Eighty-seven per cent. of the nutriment of the food enters the blood before the contents of the bowel have reached the colon, which accounts for the fact that diarrhœa confined to this latter organ does not appreciably lower the nutrition of a patient. As the contents of the small intestine pass into the colon, they only contain 5 to 10 per cent. of solid matter, and, as from a ½ to 1 pint of semi-liquid matter reaches the colon every twenty-four hours, an enormous amount of fluid must be absorbed by the colon.

Practically 95 per cent. of a meal is absorbed, the sugar and peptones into the blood and the fats by the intestinal villi (the finger-like processes lining the inside of the bowel) into the lacteals, and then through the thoracic duct to the circulation. The refuse is called the fæces and, according to Metchnikoff, consists, as to one-third of its contents, of microbes, which grow at the rate of 128,000,000,000,000 per day. Their growth is checked chiefly by phagocytes resident in the colon, which feed upon the microbes. As age advances the appetite of the phagocytes becomes more capricious, however, and they attack the tissues themselves, leaving only the binding or connective tissue. This

it is which constitutes the reason for the onset of old age.

The ingredients of a meal swallowed at eight o'clock in the morning should pass through the 24 feet down to the colon in about four and a half hours, reach the top of the ascending colon about five o'clock, and be in the sigmoid flexure next morning. Probably part of its indigestible residue may be excreted in twenty-four hours, but in anything after thirty hours it should all be expelled. The act of defæcation is partly muscular and partly due to peristaltic action of the colon.

The World's Bill of Fare.

Having now passed in review the methods whereby insoluble organised substances used as food are converted into soluble material capable of being absorbed into the blood, we must turn our attention to the food itself, and we are at once impressed by the remarkable fact that of all the substances used as food only two are directly formed for this and no other purpose. These two are milk and honey, the former being solely intended for the food of young mammals, and the latter being stored up by bees to serve them for food in the winter. Of these two, milk alone is capable unaided of sustaining human life for any length of time, but it is quite impossible to obtain a sufficient quantity of it to subserve the dietetic necessities of mankind, even although it were possible for it to maintain human beings in perfect health and vigour for any considerable period.

There is indeed no single food discovered which will do this, and so we are compelled to fall back upon certain great food staples, which have by a process of evolution proved themselves capable of effectively nourishing humanity with the minimum of undesirable effects. It is surprising to find how few of these there are when we come to look into the matter closely. The flesh and

milk of three or four domesticated animals, the flesh of three or four and the eggs of one species of domesticated birds, three great grains—wheat, rice, and maize—and half a dozen smaller and much less frequent ones, one hundred or so species of fishes and shell fish, two sugars, a dozen or two starch-containing roots and tubers, twenty or thirty fruits, forty or fifty vegetables—these constitute two-thirds of the food supply of the inhabitants of the world.

The Vegetarian Controversy.

It will be observed that these fall into the two categories of flesh and fleshless foods, and right at the threshold of our subject we must face the problem as to the status of flesh foods in human diet. We may take it for granted that, once the albumins enter the blood, it does not matter whether they are vegetable or animal, the results on nutrition ought to be the same. I am aware that much controversy has raged and is raging round this very problem at the present moment, but even the most bigoted flesh eater would admit that all proteins in the blood are equally capable of nourishing the tissues.[1] I dare not say as much for the "fleshless" eater, who is absolutely convinced that animal albumins can never build up a sound and healthy body. Any one possessed of an unbiased judgment, however, must agree with the flesh-eater's view, however much he may be

[1] During a recent visit to Yale University, Professor L. B. Mendel favoured me with his views on vegetarianism. Amongst other things he joined issue with me on this statement that "all proteins in the blood are equally capable of nourishing the tissues." He believes that the composition of proteins is so varied and complex that it is unwise to confine oneself to a limited number and kind. As it is impossible to say just what functions they subserve in the human economy, deprivation of any one of them may in time be detrimental to the body by denying it some important source of nutrition. He therefore lives on a mixed diet, although a fleshless diet appears to suit him equally well for short periods of time.

inclined to the opinion that the waste matters introduced with the animal albumins are detrimental to the best interests of the body. On the other hand, it is asserted that the nitrogenous matter obtained from vegetables is less easily digested than that which is of animal origin, a much larger percentage passing from the alimentary tract unutilised.

"Few persons live upon a purely vegetarian diet. Those who attempt it lose vigour and show languor and disinclination for physical and mental work; they become less able to resist disease. Because a vegetable diet is an economical one, it has sometimes been forced upon bodies of labourers, but uniformly the decrease in the amount of work that they are able to perform more than counterbalances the decreased expense of their food. In vegetables enough protein can be found to make it possible to substitute them for meat for the purpose of maintaining life and strength. As vegetable protein is very imperfectly digested and absorbed, a sufficient vegetable diet must be a very bulky one. It will maintain strength, and, by eating vegetable food only, one may be able to lift as much, but he will not be able to work so fast as on a mixed diet. He will lack energy and alertness. It is quite evident from man's anatomical structure, physiological functions, and habits of eating, that a mixed diet is best adapted to his needs. At the same time, it is unquestionably true that too much meat is ordinarily eaten by many individuals."

I have quoted this paragraph verbatim, from Davis's *Dietotherapy and Food in Health*, to indicate what is the position of the orthodox medical practitioner of the present day on this great subject. And this position is maintained in face of the great accumulation of evidence which is lying to hand that numbers of people live on

the very diet which we are told is unsuitable and incapable of giving good results in daily life. I am personally acquainted with many people who live on a purely vegetarian diet, *i.e.* fruits, nuts, and cereals, and I have always been envious of their physical and mental vigour and energy. There is an increasing nnmber in this country and America who live upon a purely fleshless diet, although including such products of the animal kingdom as eggs, milk, cheese, and the many milk proteins now on the market. No one can gainsay the fact that the highest degree of physical and mental health can be maintained on such a diet, and that it is infinitely more suitable than a mixed diet for a large proportion of present-day town dwellers. At the same time, those who elect to subsist on a fleshless diet would be well advised to include a considerable proportion of milk and egg protein in their diet, or, if they refuse to do so, they should at least take care to provide themselves with some of the many carefully prepared nut foods now on the market.

The objections advanced against a flesh diet may be divided into two categories:—(1) Those which are true or contain a modicum of truth—generally held by the more intelligent class of vegetarians; (2) those which are purely fanciful, and held by the over-zealous vegetarians. Amongst the former class may be mentioned the following:—

(1) Animals are liable to disease which may be communicated by their flesh, and it is suggested or tacitly assumed that cancer is much more prevalent amongst meat eaters than amongst vegetarians. Now, cancer occurs in all the vertebrates except the reptiles (almost exclusively meat eaters). It is found in mammals tame and wild, in birds tame and wild, in amphibia, in fresh-water fish and in sea-water fish in a state of nature. The

reports of the Imperial Cancer Research Fund state that the following figures represent the classification of the natives of India who die from the disease as regards their dietetic habits: one hundred and forty-six vegetarians, one hundred and thirty-seven flesh eaters, two hundred and twenty-two on a mixed diet. Cooking practically sterilises animal food, and takes away all possible chance of the conveyance of disease thereby.[1] On the other hand, more diseases are probably disseminated by the use of vegetable food than by animal food. The huge epidemics of ergotism and lathyrism, from the use of rye and millet respectively, testify to this fact, and it is well to realise that most germs belong to the vegetable kingdom.

(2) "Animals are slaughtered in such a way as to make their flesh rich in waste matter and dangerous as food." It is quite certain that if animals be over-driven to the slaughter-house and killed immediately, their flesh is not likely to be so wholesome as if they had been kept apart and quiet for say twenty-four hours, and the latter practice prevails in all abattoirs under public supervision.

[1] Whilst I was in residence at Battle Creek Sanitarium, U.S.A., Dr. J. T. Case, the well-known dietetic expert of this institution, criticised my arguments on the vegetarian controversy. He contended that it was impossible to raise a joint of meat to boiling-point during the process of cooking, and hence it could not be sterilised. I know that it is quite certain that the central portions of a joint cannot be raised much above 180° F. during cooking. But the characteristics of diseased meat are so well known that it is almost an impossibility for it to get near the dinner-table. There is no doubt that cooking alters in an important degree the so-called waste products in the meat, producing sapidity, which is a valuable peptogenic quality. It is interesting to observe how the flesh abstainer carefully endeavours to imitate this flavour in the preparation of his vegetarian nitrogenous foods. But it is equally impossible to sterilise fruit, as has been pointed out by Professor Metchnikoff, much to the discomfiture of French hygienists.

(3) "Animal flesh as sold in butchers' shops is always in a state of decay and putrefaction." This unquestionably overstates the case, although it must be admitted that the absence of life is the signal for such changes to begin, and it may be noted that they arise almost as rapidly and with as much certainty in most vegetables and many fruits. Cooking, again, minimises, if it does not entirely counteract, this condition.

(4) "Flesh is a stimulating food, and may give rise to a craving for other stimulants." All nations whatever their diet have their own form of stimulant, and I am not sure whether in this country the cause of over-indulgence in alcohol, at least amongst the female sex, should not be laid at the door of excessive drinking of tea. Tea and coffee, which are of vegetable origin, are undoubtedly much more stimulating than flesh.

(5) "The stimulants in animal food are actually excretions which have formed in the animal prior to death." It is quite true that if an animal be over-driven and overfed, waste matters will form in the flesh, which, had it lived long enough, would have been excreted by the kidneys. But these objections need not obtain, and it is quite easy to separate these waste matters during cooking, if necessary. Besides, many valuable vegetable foods contain poisonous secretions, *e.g.* the husks of nuts and the poisons in cassava root, from which tapioca is made.

Fallacious Arguments.

The second class of objections need not detain us long.

(1) The humanitarian argument. At the first blush this would appear to be a powerful reason against eating animal flesh, but careful investigations will establish the fact that an animal is killed much more expeditiously and with infinitely less cruelty than would be its lot were it left to die in a natural manner. From personal observations I am quite convinced of this fact, as

also of the fact that slaughterers are as a rule amongst the most humane of men.

(2) It is stated that no one can possibly eat meat unless it is cooked and flavoured in such a way as to disguise in some degree its origin. But the same statements may clearly be made about vegetables and many fruits.

(3) The æsthetic argument is not of great value. It loses sight of the fact that most meat eaters admit fruits with vegetables and cereals into their diet, and hence the suggestiveness of summer and all its allied pleasures may be obtained by them as well as by the vegetarian.

(4) The anatomical argument will not bear much investigation. A look at the teeth, which include cutting, tearing, and sharp grinding molars with clearly cusped edges, indicates their suitability for a mixed diet. The stomach is closely allied to that of a dog or cat, and not in the least like that of a herbivorous or graminivorous animal. The intestinal canal is only about five times the body length, as in the carnivora, instead of being from ten to twenty times, as in the herbivora. It is commonly asserted that the anthropoid apes live on fruits, nuts, and cereals, but that is not quite true, as they eat insects, worms, small birds and such other animals as they can capture. It is also quite certain that in captivity they always succumb to tuberculosis without a supply of animal food. It is a remarkable fact that tuberculosis is rarely seen in carnivora, practically never in the omnivorous pig, but it is quite common amongst cattle, chickens, pheasants, and turkeys. It is pretty certain that the anthropoid apes have only remained as such from the lack or disuse of the hunting and house-constructing faculties which caused their troglodytic cognates to develop into man.

The only argument in favour of vegetarianism to-day

that has the slightest value for the individual is the personal one, to which there is no answer. When a man says that he can exist in perfect health and full possession of his faculties on a fleshless diet, then it is pretty clear that it suits him, and he would be foolish to add flesh if for any reason he objected to it. But this is the only reason against a moderate use of flesh food which has the slightest value.

The Needs of Nutrition.

The object of nutrition is to balance the waste and repair of the body. If, therefore, we can estimate the precise amount of waste matter, calculated as nitrogen, carbon, hydrogen, and oxygen, it is quite easy to draw up a table of the dietetic requirements of the body for its maintenance in a condition of nutritive equilibrium Obviously this amount will vary according to the age and size of the individual, the amount of work he performs, the external temperature and other less important factors, such as idiosyncrasy. Practically all excretions from the body appear in the form of urea, carbonic acid, and water, and it is quite easy to construct a balance sheet of profit and loss such as the following:—

	Grammes.	Ounces.	Nitrogen.	Carbon.
Proteins . .	100	(nearly 3½)	15·5	53
Fats . . .	100	(„ 3½)	...	79
Carbohydrates .	250	(„ 8½)	...	98
			15·5	230

	Nitrogen.	Carbon.
Urine	14·4	6·16
Fæces	1·1	10·84
Respiration	...	208·00
	15·5	225·00

For all practical purposes it is sufficient to consider only the nitrogen and carbon of the food and excreta, and the above table is self-explanatory. It is quite possible to have a nitrogenous equilibrium only, and to have too little or too much of the fat and carbohydrate element. In either case health may be maintained, but in the former case too little heat and energy would be evolved, whereas in the latter case fat would be deposited in the tissues. Another method of estimation, which is perhaps more generally employed, is to calculate the amount of potential energy contained in the food and see that it corresponds with the amount of external work transacted and the amount of heat evolved for maintaining the temperature of the body and warming the breath and other excreta.

Each of the alimentary principles, when completely oxidised by burning, gives out a definite quantity of heat for every gramme burnt. This is known as the heat or caloric value, and the unit employed—called a calorie—is the amount of heat required to raise a gramme of water through 1° Centigrade.

It is usual to state them in thousands or kilocalories, and print them with a capital C. thus:—

1 grm. or $\frac{1}{30}$ part of an ounce of protein .	= 4·1 Calories.
1 ,, ,, ,, fat . .	= 9·3 ,,
1 ,, ,, ,, carbohydrate	= 4·1 ,,

By computing the amount of heat lost from the body in an instrument called a calorimeter it is quite easy to furnish a statement of the calories of food required to repair the waste. I had the good fortune in the early part of this year to be able to inspect the magnificent calorimeters in the Nutrition Laboratory, Boston,

Massachusetts, a branch of the Carnegie Institute of Washington. They were constructed under the direct supervision of the Director, Dr. Francis G. Benedict, whose great experience in the science of calorimetry is so well known. A detailed description would occupy too much space, but it may be briefly stated that each instrument consists of a chamber large enough to contain a full sized man, with double metallic walls. The space between the double walls is filled with water, and the outside of the outer wall is carefully padded with felt, and the whole instrument is enclosed in a much larger metal box, the air space between being equipped with the most elaborate automatic mechanical precautions, to prevent the escape of any heat excepting to the water. The subject to be experimented upon is confined for hours or days in the enclosed chamber, careful arrangements being made for breathing and feeding, and the heat taken up by the water is the measure of the energy produced by the combustion of the food material in his body. In testing a diet it is sufficient to know that nitrogenous equilibrium is maintained and then to estimate the gain or loss in weight and the output of energy in external work. It is stated that a body loses each day during starvation one-eightieth part of its weight, so that, were it possible to live so long, it would be all consumed in eighty days. As a rule, however, death would take place in about half that time. Proteins, fats, carbohydrates, water, and mineral matter must be supplied in the form of food to counterbalance the waste of the tissues.

Gautier has shown that the amount of food required depends upon the superficial area of the skin, because one of the most important functions of food is the maintenance of animal heat. As heat is chiefly lost

through the skin, it has been found possible to estimate the amount of food required from the skin surface. Children and small people have a much larger skin surface in proportion to their weight than adults or large people. A child of 10 lb. weight has a skin area of 3 sq. ft, whereas a man weighing 200 lb. or twenty times as much has a skin surface of 21 sq. ft., only seven times as much. The child of 10 lb. weight therefore requires one-seventh as much food as a man weighing 200 lb., instead of only one-twentieth as much.

To calculate the amount of food required by different people of varying sizes, weights, and skin surfaces, multiply the weight in pounds by the factor 4·25 and the skin area in feet by the factor 80. The sum of these two products will represent the number of calories per day required to balance the loss sustained by the dissipation of heat from the body and the loss of energy expended in vital work. If the subject is doing severe muscular exertion, then the factor 7 should be used instead of 4·25.

To ascertain the average normal weight of an adult it is only necessary to subtract 42 from the height in inches, multiply the remainder by 5½, and the result will be the normal weight in pounds. Obesity begins when the weight has increased more than one-tenth beyond the normal average.

Percentage, Composition, and Caloric Value.

It is an easy matter to determine the calorific value of a food when its composition is known. All that is necessary is to multiply its percentage value by the appropriate factor to discover the number of calories per ounce of each food principle. For protein and carbohydrates the factor is 1·16, and for fats the factor is 2·63. Conversely, to determine the percentage composition of a food when its caloric value is known,

divide by these factors. For example, bread contains about 9 per cent. of protein, 1 per cent. of fat, and 65 per cent. of carbohydrate, or

(9 × 1·16 =)	10·4 calories per ounce of protein.		
(1 × 2·63 =)	2·63	,, ,,	fat.
(65 × 0·16 =)	75·4	,, ,,	carbohydrates.

Bread has thus a total value equal to 1414 calories per pound.

The average composition of meat is 20 per cent. protein, 1·5 per cent. of fat, with a negligible quantity of carbohydrate, or

(20 × 0·16 =)	23·2 calories per ounce of protein.		
(1·15 × 2·63 =)	3·9	,, ,,	fat.

Meat has thus a total value equal to 432 calories per pound.

Proteins and fats may be either of animal or vegetable origin, but all available carbohydrates are entirely of vegetable origin; and as three-fourths of our food partakes of this character, it will be seen that we are compelled to draw upon the vegetable kingdom to that extent for our means of subsistence.

The Indispensable Protein.

The most important of these alimentary principles is protein, because it is from it that our tissues are built up. It is quite possible to live without fats or carbohydrates, or even water, for a very long time, but it is not possible to live without protein for even a short space of time. If food does not contain as much protein as is necessary, the deficit is made up at the expense of the tissues. Loss of weight need not necessarily occur, because fat may be deposited, but loss of strength, owing to waste of muscle, will most certainly take place. Insufficiency of protein in the diet is at

once made evident by a diminution of nitrogen in the form of urea in the urine, and hence it is important to see that nitrogen equilibrium is established.

It is usually stated that we require from 100 to 125 grms. of protein in twenty-four hours, *i.e.* from 3 to a little over 4 oz., and it is declared that without this quantity a man will get below par and lay himself open to disease. But man is a wonderfully accommodating creature, and each man is a law unto himself, so it is not surprising to find that it is quite possible for individuals to live on 50 grms., *i.e.* something less than 2 oz. of protein. In such circumstances, however, it is necessary to take a larger quantity of carbohydrates and fat, and it is just here that the wonderful capacity of man to live in all sorts of climates and under all sorts of conditions displays itself. In South America, where meat is plentiful, the gaucho takes more than 4 oz. of protein; whereas in India, where meat is scarce and there is great poverty, less than 2 oz. are taken, and so a great excess of carbohydrates is consumed. Truly, to parody the adage, one nation's meat is another nation's poison.

It is a fact well worth careful consideration that a low protein, usually fleshless, diet is the diet of the enslaved, stagnant, and conquered races, and diet rich in meat and of high protein value, is that of the progressive, dominant, conquering strains. Probably the chief factor lies in the amount and not the nature of the protein. A liberal supply of protein undoubtedly stimulates the vital powers, and, where open-air life is possible, tends towards great strength and abundant health, but, where this is denied, leads to excesses of all kinds in the way of stimulants, such as tea and alcohol. It is quite possible, by increasing the protein

allowance in a mixed diet which maintains the body weight and nitrogenous equilibrium, to bring about a nitrogen deficit and diminish the body weight. A diminished supply of protein, on the other hand, always leads to the opposite state of lowered vitality, but, as the friction is much less, there is less necessity for the consumption of stimulants, and diseases of a certain type, especially gout, rheumatism, and allied states, are less rife. It ought to be mentioned, however, that, as a set-off to this, other diseases are apt to arise, *e.g.* diabetes in India, beri-beri in Japan, etc.

A Specimen Diet.

For every ounce of protein swallowed, from 4 to 6 of fat and carbohydrates are necessary, and for every ounce of fat from 5 to 10 of carbohydrates are essential. Three and a half ounces of protein, *i.e.* 100 grms., the same of fat, and about 8 or 9 of carbohydrates, *i.e.* 250 grms. (all, of course, being water-free), make a very fair allowance for a man of 10½ stone in weight. Three times this amount of water and about ½ an ounce of mineral salts are also necessary. This would amount to nearly 2400 calories, and would be represented by about 17 oz. of lean meat, the same of bread and 4 oz. of butter. Of course, the diet would be much more varied than this, and might be made up as follows:—Bread, 12 oz.; meat, 6 oz.; potatoes, 10 oz.; milk, 1 pt.; butter, 1 oz.; oatmeal, 3 oz.; sugar, 3 oz.

It is a point worth observing that, wherever animal proteins are easily obtained, either from natural or economic accessibility, they are usually selected. Even in Japan, which has falsely obtained the reputation of a vegetarian country, eggs and fish form a part of the dietary and have always done so, and now that its large army has begun to know active service on an

extensive scale, the people are rapidly becoming flesh eaters.

A man doing hard muscular work would require a much more liberal dietary than the above—a slight increase in the proteins and a greatly increased quantity of carbohydrates and fat. European labourers, of whatever nationality or occupation, consume the alimentary principles in much the same proportions: Proteins, about 135 grms., or 4½ oz.; fats, 80 grms., nearly 3 oz.; carbohydrates, 500 to 700 grms., 16 to 23 oz.—representing from 3500 to 4000 calories.

It will be noted that the margin of protein consumption is by no means a large one, and this is fortunate, for it is the most costly of foods. A sedentary man, during the first week of an active open-air holiday, will consume a greatly increased supply of protein, but at the end of this time returns to his normal limit, and increases his carbohydrate allowance in order to supply the requisite force demanded by his muscular exertions. He is impelled to this course by instinct and by the discomfort produced by a greater quantity of nitrogenous residue demanding elimination by the kidneys.

Experiments demonstrate that, as the protein allowance is diminished, an increasing proportion of carbohydrate must be substituted, providing a caloric value of total food several times greater than is necessary, and finally quite impossible for the digestion to cope with.

It is difficult to reconcile these facts with those obtained by Chittenden described in Chapter X. (on Moderation), but it is quite clear that diminution of protein is more easily tolerated than its increase. Within limits, indeed, this course is desirable, and doubtless further experience will enable scientists to fix the protein optimum at a point much nearer the

protein minimum than they are at present willing to allow. Chittenden has shown that of the total amount of nitrogen thrown off by the body, nine-tenths is in the form of urea, nine-tenths of the remainder is uric acid, and nine-tenths of the remainder is xanthin. As urea contains 45 per cent. of nitrogen and protein 15 per cent., every gramme of urea excreted shows that 3 grms. of dry protein has been consumed, or in terms of nitrogen, every gramme of nitrogen excreted represents 6·25 grms. of protein consumed.

Caloric Calculations.

The amount of carbohydrate and fat will, of course, vary with the climate and amount of work, but, let us assume a diet with an allowance of 2700 calories per day in which there are 100 grms., or 3½ oz. of protein. This amounts to 410 calories, and leaves 2290 to be supplied by carbohydrate, fat or both. Accordingly, 558 grms., *i.e.* 18½ oz. of carbohydrate or 255 grms., *i.e.* 8½ oz. of fat, would supply the deficiency. But both elements almost certainly enter into the dietary, and the amount of fat consumed will depend upon the digestive capacity, and, as it is the more expensive of the two, upon the ability to purchase it. If 100 grms. or 3½ oz. be used, that would supply 930 calories, and this, with the 410 from proteid, would leave 1360 calories to be supplied by 316 grms., or 10 oz. of carbohydrate.

Carbohydrates are the chief sources of muscular force and fats of heat, so that where a man is well clad or in a warm climate very little fat need be consumed. The Japanese prefer carbohydrates to fat, as witness the rickshaw men who on working days eat rice and on holidays, fish. Inhabitants of cold countries, on the other hand, eat immense supplies of fat, and as much as 36 lb. of meat with a few pounds of tallow candle have

been consumed by an Eskimo at one sitting. Where it is well digested, a large supply of fat should always be taken, as 3 oz. of fat are equal to 7 oz. of carbohydrates, and, as their value as protein sparers is nearly equal, a less bulky diet is necessary. Cod liver oil, dripping, milk, and bacon fat are therefore excellent foods for winter.

These amounts of protein, fat, and carbohydrates are those generally recognised by scientific men to-day, and were established by Voit, Atwater and other authorities. The labours of Professor Chittenden at Yale, more fully detailed in Chapter X., have thrown considerable doubt on Voit's standard, and a new school of dietitians has arisen who adhere to what is now called the "low protein standard." Although it in no way lends its support to any particular sect or cult, it has been hailed with delight by the vegetarian section as in some respects it makes their doctrines more credible. It is found, for example, that to live on a low protein diet an exceptionally small quantity of animal food must be consumed, which the flesh abstainer is inclined to regard as superfluous. During a visit to Battle Creek Sanitarium in the early part of this year I had, as a guest at this institution, unrivalled opportunities of judging of the applicability of the low protein fleshless diet. Six or seven thousand guests or patients visit this establishment annually, and in America it is safe to say that most of them have been living on three meat meals per day, with the addition of copious libations of coffee, supplemented in the case of the men by numerous cigars and in many cases alcoholic drinks. Without any preliminary preparation, every inmate is at once placed on a low protein fleshless diet, with incredibly few bad results. There are three meals per day—8 a.m., 1 p.m., and 6 p.m., and for each one a bill of fare is provided

of an entirely novel character. The value of each food is not only set forth in calories of protein, fat, and carbohydrate, but the weight of the food and the number of "portions" served are announced. A "portion" is that quantity of any food which contains 100 calories of food units, so that if a person be allowed 2400 calories per day, eight "portions" at each of his three meals should provide them. The following is a sample bill of fare for breakfast :—

	Portions in Serving.	Calories of			Total Weight.
		Protein.	Fat.	Carbo-hydrate.	
Gluten gruel .	1	17	2	81	6 oz.
Soft boiled eggs	$\frac{7}{10}$	26	42	...	$1\frac{1}{4}$,,
Zwieback . .	$2\frac{1}{2}$	23	54	173	2 ,,
Creamed potatoes	$1\frac{1}{4}$	11	46	68	$3\frac{1}{2}$,,
Pecans . . .	2	10	174	16	1 ,,
Apple . . .	1	2	7	91	$5\frac{1}{2}$,,
		89 +	325 +	429 = (843)	$19\frac{1}{4}$,,

In this meal, therefore, 843 calories of food value were eaten, and the respective proportions of protein, fat, and carbohydrate per cent. were about 10, 35, and 50 respectively. At the next two meals the fat must be diminished and the carbohydrate increased in order that the correct proportion of 10, 30, and 60 may be observed, and at the test meal table an attendant is provided who assists the bewildered novice in arriving at the correct ratios. It is calculated that on leaving the institution quite 95 per cent. of the patients return to their ordinary diet, with, however, greater attention to moderation, simplicity, and the ordinary rules of a

hygienic life, but quite 5 per cent. are known to adhere to the flesh-abstaining diet for all time. As this system has obtained at Battle Creek Sanitarium for the last four years, Dr. J. H. Kellogg, its respected superintendent, considers that the safety and advantages of the low protein standard have been demonstrated.

Practical Summary.

1. The food of all nations consists of the five alimentary principles—protein, fat, carbohydrates, mineral salts, and water. Oxygen as obtained from the air is the only other item added to our body.

2. Nearly all food is insoluble. The object of digestion is to prepare the food for absorption into the blood.

3. The saliva converts cooked starch into dextrin and maltose or malt sugar.

4. Efficient mastication is a sovereign remedy for indigestion, and at the same time reduces the quantity of food necessary for nutrition. It also tends to the diminution of the consumption of animal food and the increase of endurance.

5. Saliva has an alkaline reaction, and it is therefore unwise to eat acids along with starchy foods.

6. The sight and smell of food and its pleasant flavour in the mouth induce a flow of gastric juice into the empty stomach; this is called psychic or "appetite" juice. Unattractive or disagreeable food is therefore calculated to produce indigestion.

7. Meat soups and well masticated bread are peptogens, *i.e.* they encourage the flow of gastric juice.

8. The gastric juice only begins the digestion of proteins. It has no power over fats and starches, at

least directly. The stomach does not absorb its contents to any extent. It is therefore only a reservoir for preparing the food for propulsion into the intestine.

9. The intestine completes the digestion of starch and proteins and entirely deals with the fats, preparing them for absorption into the blood.

10. Milk and honey are the only two substances primarily intended for food.

11. Vegetarianism is practised by most of the world's inhabitants. It is perfectly practicable for most people, but not generally considered to be the most efficient diet.

12. The only argument in favour of vegetarianism to-day is the personal one.

13. It is generally considered that the food should consist of 22½ per cent. protein, 22½ per cent. fat, and 55 per cent. carbohydrate.

14. Three and a half ounces of water-free protein, the same quantity of fat, and 8 or 9 oz. of carbohydrates should suit the requirements of the average man.

15. Hard work requires an increase in the quantity of the food.

CHAPTER II.

FOOD (SPECIAL).

LAW I.—"Eat three meals each day of plain, wholesome, solid, nourishing food, at or about the same time as far as possible."

THERE are only two foods which contain all the alimentary principles in anything like the normal proportions, namely, milk and eggs. Of these, milk is the only one primarily intended for food, the growing chick has to subsist on the yolk of the egg until it breaks the shell; but eggs contain practically no carbohydrate.

Milk and its Properties.

Milk being therefore a typical natural food, used as such by civilised and uncivilised peoples alike, is worthy of a little careful consideration, especially as it is cheap and easily digested.

Pawlow has pointed out that it calls forth very little energy for its digestion in the way of the gastric and pancreatic fluids, and further, that it requires no "appetite" juice which all other foods demand. An important point in its favour is that twelve hours after it has been ingested it has only parted with 15 per cent. of its nitrogen, whereas bread has given up 50 per cent. of its nitrogen. Hence milk is a more effective, staying, and economical food. Pawlow suggests that a new branch of dietetic experimentation should be initiated to classify foods in accordance with their economical

properties. Dr. Schwarz, an Austrian, reports that at the age of forty he is in the best of health, and for twenty-seven years has swallowed absolutely nothing but three gallons of milk per day. As the capacity of the human stomach is about three pints, this would mean eight meals of milk alone.

Milk is by no means easily tolerated by every person, and in any case is very deficient in iron, so that anæmia is almost sure to result from its prolonged administration without alternatives. The average limit of endurance for a sole milk diet is six weeks, and it is seldom judicious to continue it for anything like this length of time. It has been injected into the veins directly, and thus easily utilised by the system without any digestion in the alimentary canal, and this is an indication of its extraordinary ease of assimilation. For one who is "run down" or exhausted, the addition of three or four glasses of milk to the ordinary daily fare is often of great value. In these cases an excellent method of taking it is to sip it slowly about an hour before each meal and lie down until the meal is ready. A normal stomach an hour before food should be empty and contain no acid to coagulate the milk.

A great drawback to the use of milk is its constipating effect, and this is much increased by boiling it. It contains much more lime than lime water, and, as this exists in the form of phosphate of lime, not only does boiling increase its proportion by a loss of the watery part, but by a dissociation of its elements, so that lime water is actually formed. This lime is, however, valuable for children, and where milk is badly tolerated it may be rendered more digestible by the addition of citrate of soda in the proportion of one grain to an ounce.

The composition of cow's milk is in round figures:—

Water, 87·0; protein, 4·0; fats, 4·0; sugar, 4·5; salts, 0·5.—Total, 100.

The solids of milk consist of proteins of two kinds (caseinogen and lactalbumen), fats and carbohydrates (lactose or milk sugar), and mineral salts—chiefly phosphate of lime, carbonate of potash, and chlorides of sodium and potash. When living on cow's milk alone, to obtain the requisite quantity of carbohydrates, about nine pints require to be taken daily, and this would give far too much water, fat, and protein. The advantage of food combinations is therefore apparent even when dealing with what is looked upon as a complete food. Three-quarters of a pound of bread and three pints of milk would make a well-balanced nutritious diet capable of being easily dealt with by the stomach in two or even three meals.

Milk is not completely absorbed from the intestine. Children digest it better than adults, for the residue is 4 per cent. in the former and as much as 10 per cent. in the latter. It has been ascertained after careful and continuous measurements that children between thirteen and sixteen years of age grow four times as fast on a diet containing milk, as on one containing an equal quantity of tea or coffee.

Skim milk, it should be noted, contains all the nutriment of fresh milk, with the exception of cream or fat, and, as this can easily be supplied by a cheaper fat, it should be conserved and used as human food instead of being allotted to pigs or even as in some cities poured down the gutter.

Cream, Butter, and Cheese.

Cream contains most of the fats of milk, and has close upon ten different fatty constituents. Amongst them is lecithin, a phosphorised fat existing in the human brain. There should be about 20 per cent. of

fat in cream, but as much as 65 per cent. can be obtained by the use of a separator. Cream is not only one of the most easily digested fats, but contains as much protein and sugar of milk as milk does, the fat indeed only replacing some of the water contained in the latter. One pint of cream is of greater caloric food value than four quarts of milk.

Butter is produced from cream by churning, the albuminous envelopes of the fat globules being thus broken and the fat particles permitted to commingle and form a solid mass.

Cheese is a product of milk containing its casein and fat. The casein is precipitated by coagulating milk with rennet or simply allowing it to sour. The whey is then allowed to separate and salt is added to the curdled casein and fat. When it is kept for a long time cheese "ripens," and the curd or casein again becomes soluble in water. Its composition is approximately one-third water, one-third protein, one-third fat. A cheese weighing 20 lb. contains as much nourishment as a whole sheep weighing 60 lb., because flesh contains quite 70 per cent. of water. Its chief drawback is the great difficulty many people find in digesting it, because its fat surrounds the particles of casein like an envelope, and prevents the gastric juice from coming readily into contact with them. To promote its digestion it ought to be grated or eaten as in Scotland with oat-cake, which combination produces a complete diet. The addition of a small amount of bicarbonate of potash will easily dissolve it, and by adding milk and eggs to this solution a savoury and highly nutritious dish can be prepared.

The addition to milk of water, cream, and milk sugar is often necessary to make it more digestible, especially

in the case of infants, and this process is called "humanising" it.

Koumiss is a fermented preparation of mare's milk, and has been used for many hundreds of years in Eastern Europe.

Kephyr is a preparation of the same kind made from cow's or goat's milk. A little piece of the kephyr ferment—or, what is more usual, a little sugar and yeast—is added to the milk, and certain changes take place therein. A part of the sugar is converted into lactic acid, another part into alcohol and carbonic acid, and even the fat is converted partially into butyric acid. These acids precipitate the casein in fine particles, and by constant agitation they become still finer and gradually undergo partial digestion. The result is a sour, effervescent, weakly alcoholic milk costing about one shilling per champagne quart. One pint of this may be taken each day, gradually increasing until seven pints per day are taken, and it is held in high repute as a treatment for inflammation of the colon both in children and adults.

The Lacto-bacilline Treatment.

Probably, in this country at least, the kephyr and koumiss cures will speedily lapse into oblivion on account of the introduction of the treatment of intestinal and other affections by butter-milk or lacto-bacilline.

Butter-milk is the residue after butter is made from cream, and contains, besides water, 2½ per cent. protein, 1 per cent. fat, 3½ per cent. of sugar, with a great deal of lactic acid which has been formed from the sugar. It is largely consumed by the peasantry of Scotland and Bulgaria,—in the former country being usually eaten with oatmeal porridge or used as a beverage during harvesting and other agricultural operations. The large proportion

of centenarians in Bulgaria is attributed to its use as a daily article of diet.

As butter-milk is not easily obtained in a city, the lactic acid bacilli can now be procured in compressed tablet form or added to fresh milk in the form of a powder which, under the influence of heat, soon converts it into what is now known as "soured" or "curdled" milk.

Curdled milk has been used from time immemorial in Eastern Europe as an article of diet, and thirty or forty years ago was much in vogue in France. It is therefore the revival of an old treatment, and owes its present popularity to Metchnikoff, the director of the Pasteur Institute in Paris. In casting about in his mind for the cause of old age he was struck with the longevity of birds possessing no colon, and, being at the same time in Bulgaria, where he noted the regular use of curdled milk by its many centenarian inhabitants, he associated these two facts. Whilst investigating the causation of cholera, he had discovered that the intestines of the ordinary healthy man always contained a great number of varieties of bacteria. Some of these—called proteolytes, because they lived on the protein contents of the bowel—were found to be dangerous, forming poisons which when absorbed were harmful to the body; and others—called saccharolytes, because they lived on the starch, sugar, and dextrin—are beneficial because they hinder the development of these harmful germs. It was found that the proteolytes or harmful germs predominated in the colon, and he knew well that an acid environment was inimical to the development of these harmful microbes. He therefore concluded that the lactic acid bacilli which are saccharolytes, in the curdled milk or yoghourt, as it is called in Bulgaria, prevented the growth of the hostile micro-organisms in

the colon. Just at this time Bouchard was preaching the doctrine of auto-intoxication, and declaring that salvation lay in gastro-intestinal antisepsis, *i.e.* in killing the microbes of the digestive tube.

The scientific world was therefore thunderstruck at the appearance of Metchnikoff's great work on the utility of many of these intestinal microbes, but his doctrine stood the proof of experiment and he demonstrated that chickens reared as far as possible without intestinal microbes languished and died, whereas others fed in the same way—though with a full supply of intestinal microbes—came to perfect development. Thus in 1901 he established the fact that the microbes of the human intestine constitute for the most part a harmful flora; that these microbes by their poisonous excretions exercise a toxic effect on the organism, and that this toxic irritation causes an increase in the connective tissue of the organs and blood vessels, setting up sclerosis and finally senile decay.

This is the new doctrine of auto-intoxication or self-poisoning, and is the new theory of the causation of practically all chronic complaints. The remedy for this state of affairs is to inhibit the growth of the harmful microbes by transforming this wild and noxious intestinal flora into a well cultivated one, rich in lactic acid ferments. Curdled milk is not only the best method of effecting this transformation, but is at the same time a food material of the first order. It is therefore at present in great favour as a very valuable article of diet, being a complete food easy to digest, a powerful diuretic (*i.e.* a kidney flusher), a convenient laxative, and a tonic for the nervous system. At any rate, this is what is claimed for it by enthusiasts, but after some experience I cannot speak of it in such enraptured terms. It is certainly better

than kephyr or koumiss, because it is more nourishing and contains no alcohol, itself a strong agency in the promotion of senile decay. It must be carefully noted that in those countries where the use of soured milk is supposed to be conducive to longevity there are other powerful factors in operation. The most important of these are an open-air life with considerable muscular exercise and extreme moderation and simplicity of diet. Those people, therefore, who begin to practise the soured milk cure and still continue their dietetic indiscretions must be prepared for disastrous results. Colic, diarrhœa, and vomiting have resulted from the indiscriminate use of lactic acid ferments, and even gout and rheumatism have been initiated or precipitated by excessive or injudicious medication with them. To obtain satisfactory results the whole life must be ordered in accordance with the principles of moderation and simplicity practised in Bulgaria and other countries.

The method of preparation of curdled milk has been greatly facilitated by the almost universal use of tablets, marketed under various names and containing active lactic acid bacilli. One of the most convenient forms is prepared by Messrs. Allen & Hanbury and called "Sauerin," and in many cases it is quite sufficient to add two or three crushed "Sauerin" tablets with a little sugar to a tumblerful of milk and take this two or three times a day. By this means the curdled milk with its increasing host of lactic acid bacilli is prepared in the intestinal canal itself. It is highly probable, however, that in a sensitive person a considerable degree of discomfort may be developed, so, to obviate this, it is well to prepare the curdled milk and take it in convenient quantities throughout the day. This can easily be done by pouring a pint of freshly boiled milk into a jug.

Allow it to cool to a temperature of 100°–105° F. Add three or four tablets of "Sauerin" crushed and a tablespoonful of cane sugar or sugar of milk and mix well. Cover the vessel and maintain the same temperature for from eight to twelve hours, or until curdling takes place. When it is ready for consumption one tumblerful of this curdled milk may be taken on rising, another in the middle of the forenoon, another at tea time instead of tea, and a fourth at bed time. It is not advisable to take it at meal times, as, in common with all forms of milk, it is liable to upset the digestion.

Rennet, which is prepared from the mucous membrane of a calf's stomach and contains pepsinogen and rennin, also coagulates the casein of milk, but without the production of lactic acid.

The Defects of Eggs.

The eggs of the domestic fowl are another example of a complete food, as they contain some of all the alimentary principles. It is a very ill-balanced food, however, as there is too little carbohydrate, so that bread and butter eaten with eggs is a very natural supplement. Each egg contains 7 grms., or about one-fifth of an ounce of protein, so that, if taken alone, sixteen would be required for a day's ration. The average weight of an egg is about 1½ oz., and its food value about 70 calories. One-tenth is shell, six-tenths is white of egg or pure egg albumin, and three-tenths is yolk. Ten per cent. of an egg is fat, and this is entirely contained in the yolk, along with nuclein, cholesterin, and lecithin, all highly phosphorised ingredients.

Raw eggs are very bland, and quickly leave the stomach in an unchanged condition without exciting secretion or motion. If taken fasting, therefore, they should be quickly utilised as food without the risk of indigestion. Only a residue of 5 per cent. is undigested.

They may be taken raw with a little pepper and salt, or whipped up in beef tea, coffee, or milk. Another method is to whip up an egg with a little lemon juice and add some sugar and dilute with water or seltzogene. Brandy, rum, or wine may be added to the yolk of an egg whipped up with milk and flavoured with a little sugar.

The Cooked Form of Meat.

The flesh of domesticated or wild animals and birds forms the most important source of the protein food of mankind.

Meaty flavours are strongly peptogenic, being valuable stimulants to the whole digestive process, although raw flesh well masticated is more easily digested than when cooked.

Flesh is, of course, the muscular tissue of the animal, and its chief constituents are the contractile muscle substance called myosin, some fat and connective tissue or gristle and extractives. These extractives are unquestionably to a large extent waste matters, probably fatigue products of the active muscular tissue during life, and are chiefly acid, containing kreatin, kreatinin, sarcolactic acid, uric acid, etc. Speaking generally, all flesh consists of about 75 per cent. of water and 25 per cent. of solid matter, with an average content of 18 per cent. of protein. The flesh of birds contains the most protein, then follows that of mammals, fishes containing least of all. Flesh contains practically no carbohydrates, although, if kept sufficiently long, a chemical transformation takes place whereby a little sugar is formed.

Cooking effects several changes in meat. The colour is altered, rendering it more agreeable to the eye, the flavour is improved, there is a slight loss of water, fat, and extractives, and the connective tissue binding the fibres together is dissolved, so that the digestive juices more readily attack them.

4

When meat is placed in cold water and the temperature raised gradually, much of the extractive or flavouring matter, some of the salts and muscle juice are dissolved out, and by degrees the fibres are entirely separated. This is the process called stewing, the resultant mass containing all the nutriment of the meat, and being a savoury and easily digested dish.

Boiling is effected by plunging the piece of meat into boiling water, and so sealing the juices by coagulating the albumin of the superficial fibres. The temperature of the water should then be lowered about 30° F., and the cooking completed.

Meat is roasted by being placed in a very hot oven, whereby the superficial fibres are rapidly coagulated and the escape of the juices is prevented. The fat and extractives which accumulate in the dish are poured over the cooking mass at intervals, which continues the beneficial process and induces chemical changes that modify the flavours. Broiling or grilling is performed on a grid or over the open fire. Frying is the least satisfactory method of cooking meat. If, however, the meat is completely immersed in hot boiling oil a satisfactory result is likely to be obtained.

Fresh meat is less savoury than when kept for some time in a cool place. The albumin partly coagulates and becomes more soluble because of the formation of lactic acid.

The digestibility of the different forms of meat varies. Beef, as containing the longest muscular fibres, is the most difficult to digest, and, when properly cooked, pork, which contains the shortest muscular fibres, is the easiest. When, however, the fibres are coated with fat, badly masticated, and eaten with too many accompaniments, they are apt to disagree, especially with those who have

an intolerance for fat. Mutton and lamb are more tender than beef. All these are well mingled with fat, and should be eaten alone. Chicken, turkey, and pheasant are almost devoid of fat, and require an accompaniment of bacon or sausage.

When any of these meats are to be eaten cold, it is better that they should be specially cooked, not even a fork being inserted into the flesh whilst cooking. They should then be left untouched until quite cold, when they will be found infinitely more juicy and appetising than if cut whilst still hot and the remnant eaten as cold viands.

Truth about Beef tea.

A great deal of misunderstanding still exists in the minds of the public with regard to what is called beef tea. It is a popular mistake to credit it with nourishing properties, and there is still a great predilection in favour of its consumption by invalids. As originally prepared by Liebig and even now in most households, it is entirely composed of the extractives of meat, with perhaps a small modicum of its nutriment, about 1 per cent. of protein, to be exact. Liebig never at any time pressed its claims as a nutrient, and long ago some very convincing experiments were made which demonstrated its worthlessness for this purpose. The most notable of these was conducted on three healthy dogs of about the same weight and vigour, each being fed under careful observation in the following manner. To one was given a large supply of the best home-made beef tea, to another was given nothing but water, and the third was permitted to swallow the small cubes of meat left over after the preparation of the aforesaid beef tea and a small supply of water. The dog fed on the beef tea quickly died with symptoms of toxic poisoning, the dog restricted to pure water lived for some seventy days, whilst at the end of

two years No. 3 dog was in the best of health and still revelling in his wholesome diet of what the public have always looked upon as innutritious refuse. Truly a drastic demonstration of the folly of trusting to the nourishing properties of beef tea!

It must not, however, be supposed that this beverage is worthless. It is the rule to find that a patient is unable to take much nourishment during an acute illness, and to most of them milk, which is usually recommended, is repulsive. The digestion is impaired, the appetite is bad, the tongue is furred, and there is no desire for food, whereas there is nothing repellent about a hot, clear, non-clogging and stimulating fluid like beef tea. The truth is, the patient is better without any food until the digestive functions are resumed, and the use of beef tea procures the starvation which is so necessary, and satisfies the patient's friends—who have an inexplicable dread of absence of food—that wholesome nourishment is being taken. But beef tea has likewise a positive value in that it whets the appetite and excites the stomach to greater work, so that with the addition of white of egg, bread, crackers, or rice an agreeable diet is obtained. As an explanation of its stimulating qualities, Sir Lauder Brunton has suggested that beef tea contains an antitoxic substance which antagonises the toxins of fatigue. This hypothesis is credible, but analysis and experiment will be necessary to establish its truth.

Beef tea and beef juice vary somewhat in their composition, the latter containing sometimes a decided amount of nourishment. To make a nourishing beef tea or juice, the following instructions should be followed. Cut half a pound of lean meat into small pieces, place in a jar and add about ten tablespoonfuls or so of water between 105° and 120° F., *i.e.* just

sufficiently hot for the back of the hand to bear. Place the jar in a saucepan of water at the same temperature. Place on a stool in front of the fire so that this temperature is maintained for two hours, stirring the mass every five minutes. At the end of two hours strain through a piece of strong muslin and thoroughly squeeze out the juice, leaving nothing but dry fibre. Flavour with tomato or any other desirable agency, and consume within six hours from the time of preparation.

Vegetable Virtues.

Having thus dealt with the foods of animal origin, we must shortly turn our attention to the great class of vegetable foods, which form the chief food supply for the greater part of the inhabitants of the world. They possess certain broad characteristics in which they differ from animal foods: (1) they contain more water; (2) they contain a larger amount of starch and sugar; (3) they contain a smaller proportion of protein and fat. They are therefore more bulky, and more of them must be eaten to satisfy the demands of the system. In addition to this, however, the protein content is not so easily utilised as that of animal foods, because, being—like starch—contained in cells, it is unable to burst its envelope of cellulose, which, except in a very young fresh condition, is almost indigestible. Cooking causes starch grains to swell and burst their cell wall, whereas protein only shrinks on the application of heat. It is only after being ground to a fine powder by artificial means that vegetable protein can be digested and absorbed as easily as animal protein.

A mixed diet with a ratio of one part food of animal origin to three parts food of vegetable origin is a practical and satisfactory balance for the normal subject. In cities, however, there are many people, accustomed to sedentary occupations, whose digestive organs, rendered

weak by lack of physical exercise, are incapable of dealing with this proportion of bulky food, and who are compelled, for the sake of comfort, to eat a larger quantity of animal food—often amounting to a full half of the total. The result is that they have a greater tendency to the development of gout, rheumatism, and nervous disorders than country people.

The fats and carbohydrates of vegetable foods are easily digested and assimilated. The latter consists of sugars, starches, and cellulose. Sugars are soluble, starches become so by cooking, even dry heat converting them into dextrin, but cellulose remains quite insoluble even after cooking. It constitutes the ballast, and in brown bread, green vegetables, fruits and nuts, assists in correcting constipation.

The most common sugars have been mentioned in Chapter I. page 4. To these must be added a sixth, viz., invertose or invert sugar composed of equal parts of lævulose and glucose. Cane sugar is now obtained largely from beetroot. Maple sugar has a similar composition. Honey contains grape and fruit sugar. Syrup and treacle are simply coarse forms of cane sugar.

Sugar is agreeable to taste, induces the consumption of more food, gives strength to the muscles and helps to lay down fat. Large quantities produce alcohol and irritant acids in the bowels from fermentation. Fruits and milk contain about 5 per cent., and this is the dilution which is most suitable for consumption.

White or Brown Bread?

The comprehensive name of "cereals" includes all the grains used for food. They contain mineral salts, starch, fat, a protein called gluten and a little cellulose. They are usually ground down before being used as food. The outer or husky layer is called the bran, which is

removed by milling, as is also what is called the germ. This is unfortunate, because the latter contains a large quantity of fat and protein, but it is apt to spoil the flour on account of its fatty content. Their composition is somewhat as follows:—Water, 14·5 per cent.; protein, 11·0 per cent.; fat, 1·0 per cent.; starch and sugar, 69·0 per cent.; cellulose, 2·5 per cent.; mineral matter, 2·0 per cent. Flour contains a little more starch and a little less protein than rice. Oatmeal contains a little more protein and fat than this.

The simplest way of using flour is by baking it with a little water. In this way ship biscuits are made, but they are too hard and difficult to digest. For this reason a more advanced process is employed by adding yeast and setting it aside in a warm place. The yeast cells grow, converting some of the starch into sugar, then into alcohol and carbonic acid gas. This fills the dough with bubbles, and the finished product is called bread. The fermentation ceases when the bread is ready. The yeast is killed, and most of the alcohol and carbonic acid driven off. As there is some loss in this process of manufacture, other methods have been employed, *e.g.* gas may be forced into the dough under pressure. This is the aerated process. Or baking powders, which when wetted liberate carbonic acid gas, may be employed.

Toasting increases the digestibility of bread, but ordinary toast is inferior to zwieback. This is prepared by cutting the bread into moderate slices and placing them on their edge in the oven or other dry warm place until they are dried or cooked through and through. In this state they compel mastication and insalivation in people who are too careless to attend to these processes otherwise.

Whole-meal bread is theoretically more nutritious, because it contains less starch and more protein than white bread, and a great deal more husky fibre or cellulose. Its nutriment is, however, so combined with indigestible material that it is most difficult of absorption, and hence a great proportion of it is cast off in the fæces. White bread leaves 4½ per cent. of its residue in the bowel, whereas brown bread leaves as much as 14 per cent. Many people persist in eating brown bread under the impression that it is good for indigestion, and frequently perpetuate a chronic gastric catarrh which would speedily disappear were they to cease using it. Probably in a considerable number of cases it is of value as a laxative, but even in this respect its good qualities have been overestimated, as it is just as likely to set up irritation in the bowel as in the stomach.

Bread made from good malted white flour is infinitely to be preferred, as much of its insoluble starch is converted into maltose and dextrin, and these are much more readily and thoroughly absorbed into the blood.

Rice contains practically no fat and very little protein, although the product called "unpolished," which is eaten by the Japanese, has quite as much protein as flour and is quite as nutritious.

Roots and Green Foods.

Roots and tubers are largely used as articles of diet, and consist chiefly of starch and sugar. The potato, which is most valuable, contains only 18 per cent. of starch, and is hence much used by diabetics in preference to wheaten flour. Onions are greatly prized for their medicinal qualities, acting as laxatives, expectorants, and as incentives to a good complexion. Tapioca, arrowroot, and sago are prepared from roots, and are almost pure starches.

Peas, beans, and lentils are amongst the most nutritious

of food products. Their average composition is:—Water, 10 per cent.; protein, 25 per cent.; fat, 1 per cent.; carbohydrates, 60 per cent.; ash, 4 per cent.—Total, 100 per cent. They are, however, most difficult of digestion and absorption, quite as much as 40 per cent. of their protein being unabsorbed when cooked by simple boiling. When ground into a fine flour or prepared as a purée they are much more thoroughly digested and absorbed, although their food value is not so great as one would expect, as only a certain proportion of them can be utilised by most people.

Green vegetables are chiefly used because of the mineral salts which they convey to the system in a natural form. For this reason they should be cooked by a steaming process, as the French do, and not boiled as in this country, when their valuable saline constituents are lost. They are not easily digested by many people, although cauliflower, celery, and asparagus when cooked should agree with almost any one. Lettuce and tomatoes are the only vegetables which should be eaten raw. Their functions in the body may be epitomised as (1) laxative; (2) solvent of deposited foreign matter such as uric acid salts; (3) nutritious to the bones and teeth. In a general way they may be classed as blood purifiers, and used as such.

Fruits, Nuts, and Fungi.

Fruits may be divided into: (1) flavour fruits, (2) food fruits. The former contain little but water, salts and fruit acids, with a little sugar. The latter, amongst which are comprised the fig, date, prune, raisin, when dried, possess decided nutritive qualities, having as much as 5 per cent. of protein and 60 per cent. of starch in their composition. Like vegetables they are (1) laxative, (2) antiscorbutic, (3) diuretic, (4) peptogenic, (5) nutritive, (6) diluent and demulcent. Bananas

are the most nutritious raw fruit, and, when dried and ground, a meal is prepared which has the same value as rice. The banana is easily digested, and contains little or no starch, but an abundance of sugar.

Nuts are rapidly coming into favour as highly nutritious, and, when properly prepared, easily digested articles of diet. They contain an average of 20 per cent. of protein, 50 per cent. of fat, and 20 per cent. of starch. If the husk can be removed, as in almonds by blanching, and they are carefully ground into powder by a nut mill, they may be eaten with impunity by most people. When eaten without being ground, however, they are apt to disagree with almost any one, as they are most difficult to digest. Where they form the principal portion of the diet, as with the fruitarians or vegetarians, it is preferable that they be carefully prepared by experts either in the form of butter or a cooked food resembling minced meat.

Fungi contain a certain proportion of protein, but they are most indigestible on account of the large quantity of cellulose they possess. Irish moss, Iceland moss, and Japanese seaweed or agar-agar belong to the same category.

Excess of Salt.

Spices and condiments possess no nutritive value, but are used as relishes, and are supposed to aid digestion by stimulating the organs to pour forth more gastric fluids. But as this is chiefly mucus, they do more harm than good. They are also productive of many cases of chronic catarrh of the throat, on account of their local irritant qualities.

Health cannot be maintained without a due proportion of mineral salts in our food, but the only one which need be added to our daily menu is salt or chloride of sodium. This is continued in all the fluids

and tissues of the body, gives relish to the food, and improves the appetite. It both stimulates the kidneys and the bowels, the latter being often encouraged to act freely by a morning draught of water containing some common salt. Most of us are inclined to add too much salt to our food after cooking, and probably ten times too much is already added during that process.

Where any special mineral ingredient is required by the system it may be more agreeable taken in the form of food. For example, iron is found in prunes, apples, lettuce, figs, beans, peas, lentils, potatoes, asparagus, strawberries, and spinach; calcium or lime is to be found in milk, figs, cabbage, and lentils; sulphur in peas, beans, potatoes, asparagus, and cabbage; phosphorus in beans, peas, rice, and milk; magnesium in peas, beans, cocoa-nuts, barley, and rice; chlorine in milk, lentils, asparagus, and cabbage; sodium in lentils, figs, and asparagus; potassium in beans, lentils, peas, and potato. Mineral salts in general may be found in large quantities in proportion to food values in lentils, peas, beans, cocoa-nuts, potatoes, milk, rice, figs, apples, barley, cabbage, and chestnuts.

In health any excess of common salt is easily disposed of by the kidneys. But there are conditions in which this does not take place, but where the salt remains in the tissues and attracts to itself a good deal of water, producing a veritable water-logging of many of the internal organs. Long before this can be detected many minor discomforts, such as nasal catarrh, are apt to arise. Hence it is wise to refrain from taking added salt in our food.

With such a large selection of nourishing substances at hand, one would think there would be little difficulty in suiting the digestion and assimilative capacities of every

individual. But we all know that this is not so. Probably because of the tendency to congregate in cities, the digestion of modern man has become much more capricious and more sensitive to the toxic contents of food substances, although doubtless the spread of education has something to do with the popular interest in what is the best quantity and what are the best qualities of our eatables.

The Problem of Purins.

We have already seen that meat juices and beef teas are practically excretions formed by the animal whilst alive, which have failed to be discharged in the ordinary way. It is known that these substances are not nutritious, although they have a large nitrogenous content called "purins," and that very many people, especially those of a gouty tendency, are extremely susceptible to their toxic influence.

Although purins are discovered in fairly large quantities in the urine, chiefly in the shape of uric acid, they are not all derived from our food, but many of them are produced by the bodily activities, being due to the wear and tear of the cells. Hence we speak of "exogenous" purins, those introduced in the food, and "endogenous" purins, those formed by the protoplasmic activity of the body. The formation of the latter is a normal process in the functioning of the body, and the quantity is a question of temperament and constitution. Exogenous purins, on the other hand, are contained in our food, and are to be found in tea, coffee, cocoa, meat soups, beef tea, gravies, fish, flesh and fowl (especially in the glandular organs such as liver, sweetbread, and kidneys), in peas, beans, lentils, brown bread, oatmeal, mushrooms, asparagus, onions, spinach, malt liquors, and strawberries.

When these foods are partaken of in large quantities a large quantity of "uric acid" appears in the urine, and

in the great majority of cases no evil results accrue. In a small but increasing proportion of people, however, the purins are liable to cause harm, either because they accumulate in the body to a dangerous extent or because the tissues are extremely susceptible to their influence. The result is that headaches, rheumatism, and other maladies are apt to occur, and some have gone so far as to say that all bodily disease is due to the retention of this substance.

I am satisfied that tea, coffee, cocoa, meat soups, beef tea, and gravies when taken to excess—and it is to be noted that this is a relative term—are inclined to produce headaches and other discomforts and probably disease, and should therefore be expunged from the dietary altogether or taken in extremely small quantities. I am not satisfied that the purins contained in any of the other foods mentioned are present in large enough quantities to produce any serious bodily discomfort or disease. I am certain that when these customary nourishing—though purin-containing—foods are completely cut out of the dietary, many people find it difficult to take enough food to satisfy their bodily requirements; and hence anæmia, exhaustion, and lack of vitality are likely to ensue. This is because purins, being peptogenic, decidedly aid digestion, and familiar nourishing foods which do not contain any are much more difficult of digestion and assimilation. Hence too little food is apt to be taken and weakness produced. As tea, coffee, cocoa, meat soups, beef tea, and gravies contain practically no nourishment, but contain by far the largest proportion of purins, nothing is lost by excluding them from the dietary; and, when this has been done, in the vast majority of cases no harm is done by the purins contained in the other nourishing foods mentioned.

Where such harm does occur, there is no alternative to making the best of it and living on a purin-free dietary with all its limitations. In such cases eggs (which must be perfectly fresh), milk, cheese, nuts (excepting pea-nuts), fruits, and cereals (unless those mentioned previously) must constitute the major portion of the dietary.

Cases for Caution.

But there are other poisons to be found in foods which are quite digestible and suitable for human diet, and their discovery in recent years accounts for the failure to make peas, beans, lentils, nuts, cheese, etc.—all theoretically excellent foods—popular staple articles of diet. Most people can safely include those substances in their dietetic list, but it is the exception for them to be used as the chief source of protein. For this purpose they can hardly be relied upon for more than one-fifth of the requirements of the body, although a small proportion of people can utilise every scrap of their nutriment.

It has remained for modern investigation to demonstrate that there is a scientific reason for this non-suitability. It is found that beans contain an aromatic oil and bitter alkaloid, which even in small quantities are not tolerated by the susceptible stomach, while in larger quantities they act as irritants to the average person. Pea-nuts, which are really legumes, are sometimes quite as harmful as beans, and contain the same toxic principle, and a vetch called lathyrus, a close relation to the bean, is the active agent in the production of that deadly scourge of cattle ranches known as lathyrism. Even in the feeding of horses and cattle it is unwise to use beans in large quantities, inflammation of the stomach, flatulence, and loss of appetite being quickly produced.

Nuts, like beans, contain very large quantities of

easily digested protein, but unfortunately share the same defect of containing a strongly irritating substance, partly in the kernel but chiefly in the skin which surrounds the kernel. Where this skin can be removed, as in almonds by blanching, the nuts may be tolerated, and, if carefully masticated, serve as highly nutritious articles of diet. Many cases of colic and obscure pains in the abdomen are to be found in fruitarians who depend chiefly on nuts for their supply of protein. As this trouble rarely arises from suitable nut-containing foods, prepared by experienced manufacturers, I would counsel fruitarians to eschew the raw nuts and depend for their supplies on some well tried brand of nut food.

Cereals as a class are wonderfully free from irritating and poisonous properties, although it is well to be on one's guard when using rye, to ensure its freedom from contamination with ergot, a parasitic fungus responsible for that convulsive and paralysing disease called ergotism.

Tapioca is obtained from the cassava root by crushing and evaporation, so as to rid it completely of its juice, which is of a most poisonous character. Fruits have always had a reputation for producing diarrhœa and other intestinal ailments, but it is surprising that the disasters from this source are not more numerous, when one considers the enormous amount of fruit which is eaten in this country, much of which is gathered unripe and attains its ripe condition without exposure to the fructifying rays of the sun; it is quite certain that every now and again a mass of indigestible cellulose is swallowed instead of some easily assimilated fruit sugar. In such circumstances, of course, serious results are apt to ensue. Even, however, when fruit is perfectly ripe, there is quite a large proportion of people to whose digestion

many species are repugnant. The chief offenders are strawberries, oranges, cherries, raspberries, and gooseberries.

Shell-fish of all kinds have always had an unenviable reputation for toxic properties and the production of nettle-rash, and now that it has been abundantly demonstrated that typhoid fever can be communicated by oysters and mussels, special precautions should be always taken before indulging in such hazardous luxuries.

On account of its manner of preparation, cheese is never above suspicion. The agreeable flavouring properties which develop in cheese as a result of its ripening are often the cause of much digestive irritation and frequently induce constipation, whilst every now and again a specially poisonous substance called tyrotoxicon is discovered in even the most harmless-looking cheese.

Personal Peculiarities.

Doubtless some of the injurious effects known to be produced by diet are attributable to idiosyncrasy, and some remarkable cases are detailed in the annals of medicine. One would hardly expect to find honey amongst the irritant foods, but it is frequently provocative of vomiting and diarrhœa, and cases are on record where even a poultice of honey induced this untoward effect. There are many instances in which meat, nutmeg, sugar, or strawberries cannot be taken without instant vomiting, and a little boy of a particularly susceptible family has been killed by eating one strawberry. A case is mentioned where vinegar always produced hæmorrhage, where vomiting always followed coffee, and where the slightest dose of manna had a similar effect.

Of all foods, perhaps the one which most frequently induces trouble is the egg. Swelling of the lips or spots on the face, vomiting, syncope, and many other alarming symptoms are described by medical men as following the

ingestion of an egg, and this has occurred even though it was mixed with coffee quite unknown to the partaker thereof.

One individual could not eat rice in any shape or form without extreme distress, spasmodic asthma being the most violent symptom. On one occasion he took lunch with a friend in chambers, only partaking of bread, cheese, and bottled beer. He was seized with the usual symptoms of rice-poisoning, and it was then discovered that a few grains of rice had been put into each bottle of beer for the purpose of exciting a secondary fermentation.

The most remarkable case of food idiosyncrasy known to science, however, is that of David Waller, who lived about the year 1780. To him wheat flour in any form proved a terrible poison, and he used to say that of two equal quantities of tartar emetic and flour, not more than a dose of the former, he would rather swallow the tartar emetic than the flour. Wheaten flour eaten in any form was followed in two minutes by the most deadly symptoms, lasting for close on a fortnight, and even the smell of the wheat produced distressing consequences.

In such circumstances it is of great importance that each one should give the most diligent attention to his means of sustenance, so that, whilst he conforms to the principles we have just elucidated, he should discover for himself individual articles of diet which are unsuitable in his own case. This, however, does not sanction anything like a morbid introspection with regard to daily food, but simply discrimination on the basis of observed facts.

The Programme of Meals.

It may appear strange that there should be any diversity of opinion on the question of the number and time of the meals, accustomed as we are to breakfast,

dinner, tea and supper, at more or less regular intervals. But we are apt to forget that in our own past history there have been many changes in this respect, and in seeking for a reason for this variability we find that climate, hours, and conditions of labour and temperament are all factors of great importance.

The one-meal-a-day system we may dismiss as a freak, as it is founded on a misconception of physiological facts and on the dictum of Dr. Abernethy, who is reported to have said, "One-fourth of all a man eats sustains him, the balance he retains at his risk." It will be found that most of the advocates of this method are vegetarians, and, as they are compelled to eat a much larger meal than is the usual custom, a much longer period is taken to digest and assimilate it than would be the case on a mixed diet. A certain amount of time may be apparently saved, but it must be at the cost of efficiency of work and even economy of food, for it is found that the body is unable to take advantage of such a flood of nourishment poured into it at one time. In the end dilatation of the stomach is bound to take place, on account of the mechanical power of the stomach being overburdened by the mere weight of food.

The evidence in favour of a two-meal-a-day system is very much stronger, and the method is supported by eminent and influential dietetic reformers, as well as by many thousands of people who have found it greatly to their advantage and comfort. The Continental system of a light repast of coffee and rolls at the hour of waking, with a substantial dejeuner any time between 11 a.m. and 1 p.m. and a dinner between 6 and 8 p.m., approximates closely to this method. On close investigation it will usually be found, however, that in addition to the two important meals, two much lighter

ones are sandwiched between them. One pint of hot milk with coffee and rolls at 6.30 or 7 a.m. and again at 5 p.m. is not to be despised as a nutritious agency and a means of supplying much-needed fluid to assist in the assimilation of the food.

There is, however, a large section of people, chiefly in America, who adhere to the system in its rigidity, and amongst them may be mentioned Dr. Dewey and Dr. Hemmeter. Dr. Kellogg, of Battle Creek, has a Sanitarium of 800 patients, which was conducted until recently on a system of 8 a.m. breakfast and 2 p.m. dinner with nothing but hot water between. I am pleased to be able to record that on my recent visit to Battle Creek I found that the three-meals-a-day system had been substituted, and has been found in every way more satisfactory and hygienic than the old method.

The No-Breakfast Plan.

Dr. Dewey was a strong advocate of the no-breakfast plan, taking his two meals at 1 p.m. and 7.30 p.m. respectively. He claimed for this method that it will make one more vigorous and mentally brighter, will augment nutrition and strength, and will improve digestion and assimilation. Naturally the meals are increased in bulk as compared with the four-meal-a-day system, and it is just in this fact that one may find an explanation of the variety of systems in vogue. The man who takes a good breakfast and midday meal as a rule eats very little at his two later repasts, so that he is ready for his breakfast. The man, however, who takes a heavy meal at 7.30 p.m., especially if he be employed at a sedentary occupation, is quite unfitted for a heavy breakfast next morning. Science does not appear to support the theoretic argument advanced for the no-breakfast plan that most of our uric acid is

excreted in the morning hours, and that the fresh dose of uric acid contained in tea, coffee, and a meat breakfast prevents its proper excretion.

Whatever may be true of other countries, the average man in this country finds that it is much better to take a good, substantial breakfast, and most people find that they are incapable of very much work before it. A Highlander never faces the ascent of a mountain without a good meal in his stomach, and the late Dr. Milner Fothergill used to say, "I would always back a good breakfaster, from a boy to a game cockerel; a good meal to begin the day is a good foundation." Whilst resident medical officer of a fever hospital, I was always advised by the visiting physician never to make a night visit to one of the patients without eating some food first, as quite a number of my predecessors had neglected this rule and succumbed to infectious diseases. I cannot answer for the truth of this statement, but I know that a late eminent surgeon used to look upon the inability to eat breakfast as the initial symptom of a breakdown.

The best interests of the population in these islands will be served by a system which allows five hours between breakfast and dinner and six hours between dinner and supper. This allows little enough time for the normal stomach to deal with the digestion and removal of its contents, and all that need be taken in addition is a supply of pure (hot or cold) water an hour or more before the first meal and three hours after the last meal, and two cups of weak China tea in the middle of the afternoon.

Every-day Errors of Diet.

Usually, however, three hours or so after the midday meal, a decoction of highly saccharine tea with bread and butter and pastry is swallowed, which, in the average

person, can only sooner or later lead to indigestion. It is not too much to say that in most cases the nutriment furnished at this meal is quite superfluous, and where it does not produce indigestion, because the digestive and assimilative processes are sufficiently strong to cope with it, almost invariably leads to obesity. Even only half an ounce extra per day means a quarter of a pound per week, or a stone per year.

As has been pointed out several times already, the most important factors of a good digestion are efficient mastication and insalivation. It has been recently shown by Sir William Macewen that imperfect mastication is the most probable cause of appendicitis. To quote his own words: "The standing lunch eaten against time, whilst the mind is fully occupied with business—the food, instead of being chewed and mixed with the saliva, being simply washed down as a bolus with some fluid—is one of the best ways of not only producing indigestion, but of ultimately causing appendicular mischief. Man has neither a crop like a bird nor a cæcum like a horse, and therefore he has no provision for bolted food."

He quotes the case of a French lady who had never been ill in her life, but who had consulted doctors in every country in the world, had a general chat with them as to how best to maintain her health, and then had any medicine they prescribed for her made up and carefully locked away. "But," she added, "I have never been ill; I believe the greater number of maladies arise from indigestion, and that indigestion occurs from too fast eating; whereas I eat slowly, and many times I am ashamed as I am the last to put down my fork."

A bad dietetic habit which appears to be extremely widespread is that of consuming great quantities of fluid

with the meals. Indeed, in America, where dyspepsia is almost universal, the usual preliminary to every meal is a large glass of iced water. It is to be remembered that the stomach does not absorb fluids, but expels them into the bowel, and this must take place before it deals with the solids; so that not only is the gastric juice weakened by dilution, but delay occurs in digestion. If any fluid be drunk at meals it should not be between bites of solid food, but in small sips at the end of the meal, and always in less quantity than half a pint. Tea and coffee should never be taken by persons with a weak digestion.

The time set apart for meals should be sacred, and, if possible, a little quiet rest should be indulged in just before sitting down. Whether this be possible or not, it is certain that a period of bodily inactivity for twenty or thirty minutes after a meal is in most cases essential to a healthy digestion. All fretfulness, irritability of temper, worry, excitability, and other passionate and emotional exhibitions should be carefully eschewed at meal times. Nothing but agreeable topics should be permitted at the table. There is every hygienic warrant for the custom amongst the upper classes of donning evening dress for the last meal of the day.

Undesirable Mixtures.

Too much mixing of food at meal times is to be avoided. The fewer the items of any one meal the more easily they can be digested, and it has been suggested that in many cases four small meals would be the best course to adopt, making the first and third chiefly carbohydrate and the second and fourth chiefly protein. There is no doubt this would answer very well in some cases, but, generally speaking, three mixed meals are more acceptable.

Those with weak digestions will find it wise not to

partake of vegetables and fruit at the same meal. Fruit and milk is always a bad combination, although cream may be taken without any deleterious effect. Cooked fruit is always more acid than raw fruit, and it is to be remembered that the addition of sugar does not correct but only masks the excessive acidity. Cane sugar in excess often produces severe intestinal indigestion. Acid fruit is contra-indicated in many cases altogether.

Brown bread is a frequent cause of indigestion, its great quantity of cellulose and husky fibre producing irritation of the stomach. This statement does not apply to malted breads made with white flour, which are less irritating and are much more valuable for constipation than whole-meal breads.

One should try to sit down to each meal at the same time every day, as the digestive juices lose their virtue if they are kept waiting or are not used with regularity. Meat should be cut into small pieces across the grain. If, after this and careful mastication, it remains a tough fibrous mass in the mouth, it should not be swallowed. Great advantage is to be derived from a distinct break between the courses of a meal, and, if talking be indulged in, it is important to see that it does not encourage a premature swallowing of the food. "Mastication with moderation" should be the motto for meal times.

Meal times may be very well 8.15 a.m., 1.15 p.m., Breakfast. and 6.45 or 7 p.m. and nothing should be eaten between meals. The first course at breakfast should always consist of fruit, preferably one of the food fruits such as bananas, although apples, oranges, and melons are quite permissible where they can be digested. Bananas especially should be extremely well masticated, and no child below the age of six should ever eat them at all. It is a distinct advantage to allow a few minutes to

intervene between the fruit course and the next, which is usually a cooked cereal.

I must here enter a protest against the universal use of the most popular breakfast cereal, namely, oatmeal porridge, as it is usually cooked and eaten. I was reared amidst a plethora of porridge. I yield to no one in the attractiveness of the dish when cooked, as it should be, for two hours, and supped, as it should be, with plenty of milky cream. Theoretically, its nutritive value is very high, and for those who can digest it and assimilate it its practical value is equally great. But its sloppy nature lends itself with too much facility to "bolting," and hence it comes that it is usually permitted to slip into the stomach without a pretence of mastication and insalivation. Whether this has anything to do with its power of inducing cutaneous eruptions, popularly ascribed to its "heating" properties, I know not, but it is quite certain that in country districts in Scotland where it is freely used there is more dyspepsia than anywhere else in my experience. Strong tea, badly infused, is doubtless a factor in the production of this ailment, but careless mastication is the principal cause, and for this reason a dry cereal such as Force, Triscuit, Grapenuts, etc., or Zwieback, is much more suitable and compels mastication. There is no objection to oatmeal porridge cooked very firm, and, instead of being supped in the Scottish style, eaten with brown or malted bread with butter.

Many people can quite conveniently omit this course and take a piece of white fish, one or two rashers of bacon with or without an egg, or simply one or two soft boiled or poached eggs with a sufficiency of bread and butter. The usual hotel breakfast of porridge, fish, bacon or ham and eggs is only capable of being tolerated

by the average man for the short period of an active summer holiday. One or two cups of weak China tea with a little cream and sugar or saccharine may be sipped at the close of the meal.

The typical English dinner, consisting of soup, fish, joint, sweet, bread and cheese and dessert, followed by a cup of coffee, is much too heavy to be indulged in by the business man in the middle of the day. Few have the leisure to spare for the digestion of such a meal, and in any case it provides much too great a quantity of protein to be safe. Most business men will find that it is wise to confine their attention to one form of animal food at the midday meal, and in the evening to take a meal consisting solely of bread and fruit, with possibly the addition of an egg. Dinner.

For those who consider this method much too Spartan in its severity, I counsel the division of the dinner into two, taking the fish at the evening meal and the joint in the middle of the day. One or both of these meals may with advantage be commenced with a small supply of soup. Soup contains a considerable amount of nutritious material in an easily assimilable form, thus relieving the feeling of fatigue so often found at the beginning of a meal, and actually encourages a desire for more food. Not only so, but it contains a large quantity of peptogenic substances, and we have seen that these, along with dextrin, promote the flow of the gastric juice. Hence the restoring qualities of a plate of soup and a piece of bread, the latter being partly converted into dextrin in the mouth by the aid of the saliva. Six or eight ounces of beef, mutton, lamb, poultry, or game may well follow the soup, and should be accompanied by one or two green vegetables, with sometimes one or two potatoes. Sweets or pudding may be omitted at this meal, and a dish of

stewed apples or prunes and rice, or even a baked apple, may complete the meal. A biscuit with butter or a small piece of cheese may be added in some cases. There is no necessity to drink anything at the meal, although 4 or 5 oz. of water may be sipped without much harm ensuing.

Supper. A slice of Hovis or malted bread with butter, 1 egg, and a plate of stewed prunes will be sufficient at supper time for the needs of most sedentary workers. Many prefer to combine their tea and supper and add a piece of fish and some milk pudding, with the concomitant of a cup of tea, but this is hardly a physiological combination. Soup, fish, pudding, stewed fruit, and a little cheese answers much better.

If we analyse the day's feeding recommended, we shall find that it is constituted as in table opposite.

As every gramme of protein is capable of developing 4·1 calories, 421 calories represent as near as possible 100 grms. or 3½ oz. of protein, the recognised amount in a standard diet.

Each gramme of fat is capable of developing 9·3 calories, hence 635 calories represent 68 grms. or 2¼ oz. of fat, quite enough for a townsman or sedentary worker.

Each gramme of carbohydrate can develop 4·1 calories, hence 1086 calories will represent 265 grms. of carbohydrate, or nearly 9 oz.

This gives a total amount of 14¾ oz. water-free food. We found, however, that 57½ oz. of actual food were consumed at the three meals, and the extra 42 oz. represent the water added during the process of cooking or contained in the original food stuff.

Diet in Dyspepsia. Any one who has carefully followed the above remarks and who is content to apply them daily will not be at all likely to suffer from indigestion. Every victim of that

unfortunate malady, however, would do well to avoid the following articles: rich soups, or in general any sloppy articles of diet, veal, pork, hashes, stews, boiled, stewed,

	Calories of			
	Protein.	Fat.	Carbo-hydrate.	Ounces.
Breakfast—				
Banana	5	6	89	3½
Cooked cereal . . .	7	1	67	¾
Milk	22	66	34	6
Bacon	12	188	0	2
Egg	26	42	0	1¼
Sugar	...	...	25	¼
Marmalade	...	...	25	¼
Butter	1	99	...	½
Bread	24	8	168	4
	97	410	408	18½
Dinner—				
Soup (tomato)	14	50	11	4¾
Bread	6	2	42	1
Meat (beef)	160	20	...	4
Potatoes	7	1	67	3
Cauliflower	3	15	7	3
Pudding (sago)	2	2	96	3½
Stewed prunes	3	1	96	3¾
Cheese	5	19	1	¼
Biscuit	3	...	20	¼
	203	110	340	23½
Supper—				
Bread	24	8	168	4
Butter	1	99	...	½
Fish	95	5	...	5
Stewed apples	1	3	170	6
	121	115	338	15½
Totals	421	635	1086	57½

baked and re-cooked meat, rabbit, salted or corned beef, gravies, fried foods, liver, kidney, salted, smoked or preserved fish, goose, duck, sausage, crabs, lobster, salmon, pies, pastry, cheese, nuts, pickles, crude vegetables like young potatoes, carrots, parsnips, turnips, cucumbers, fresh bread, excessively sweet dishes apt to undergo fermentation, unripe acid fruit, ice cream, ices, malt or spirituous liquors.

A little clear thin soup, almost any white fish, mutton, chicken, lamb, game, boiled, poached, or raw eggs; simple farinaceous foods, if special care be taken in mastication, green peas, cauliflower, stewed celery, vegetable marrow, asparagus, baked apples, and ripe fruit may usually be eaten with impunity. It is important, however, not to restrict the diet too closely, or the patient will soon suffer from malnutrition. Flint says: "I have never known a dyspeptic to recover vigorous health who undertook to live upon a strictly regulated diet, and I have never known of an instance of a healthy person living according to a strict dietetic system who did not become a dyspeptic." Appetite is often the best guide in indigestion.

Diet in Constipation.

Constipation, which is one of the most common troubles of civilised existence, is not really a disease, hence the majority of its victims rarely display any serious departure from the healthy state. It is usually a result of irregular or diminished activity of the muscular coat of the bowel or a diminution of the fluidity of its contents. Irregular peristaltic action results in spastic or spasmodic constipation, and this is met with in nervous people who are subject to much excitement, worry, grief, or mental strain, the removal of which usually brings about a cure.

Diminished peristaltic action produces atonic constipation, and in this condition dietetic treatment is of immense

importance. Foods, therefore, that contain an indigestible residue are prescribed for such patients, although it is important to note that sufferers from the previous form of constipation would find that such foods would exaggerate their malady. Whole-meal, bran, brown or malted bread should always be used in atonic constipation. Gingerbread is often successful. A proportion of sawdust is occasionally added to the loaf with advantage. Plenty of butter with marmalade, honey, golden syrup, or black treacle forms a useful addition to the bread. Malted oatmeal porridge eaten with black treacle is especially useful. Vegetables of all kinds should be used if there be no dyspepsia, but when this is present these and many other of the foods here mentioned are interdicted. Boiled Spanish onions taken each evening for supper often cure the most obstinate cases of constipation.

The mainstay of such a diet should, however, be fruit of all kinds, especially prunes, figs, dates, raisins, and tamarinds. If necessary, some of these should be taken at each meal, singly or combined, *e.g.*, prunes with raisins, figs with prunes, etc. A few senna pods may be added to the prunes whilst they are being stewed. A home-made syrup of figs is often successful. Japanese seaweed or agar-agar may be usefully added to soups.

Practical Summary.

1. Milk is the typical natural food, and is used as such by all nations and peoples. Its great defects are its constipating qualities and its liability to contamination with disease germs.

2. Skim-milk, cream, butter and cheese are all valuable products made from milk.

3. Butter-milk or "curdled" milk, which is manu-

factured by adding active cultures of lactic acid bacilli to new milk, is much in vogue as a nutrient and intestinal antiseptic. It is not free from danger when used as an adjunct to an ill-balanced dietary.

4. Eggs are very nutritious, and contain much protein and fat. Sixteen of them if used alone would be required for a day's ration.

5. Flesh forms the most important supply of the protein food of civilised mankind, and when cooked is highly flavoured and easily digested.

6. Beef tea contains practically no nourishment. It is chiefly of value as a stimulant.

7. Vegetable foods contain more water, more sugar and starch, and less protein and fat than animal foods. They are therefore more bulky, and must be eaten in greater quantity to satisfy nutritive requirements.

8. Brown bread is more indigestible and less nutritious than white bread, and hence is more valuable as a laxative.

9. Peas, beans, and lentils are theoretically amongst the most nutritious of food products, but are not easily tolerated by the average man.

10. Vegetables and fruits are valuable laxatives, diuretics, and agencies for purifying the blood.

11. Nuts are highly nutritious, and when properly prepared easily digested articles of diet. Pine kernels and almonds should be specially mentioned in this connection.

12. Common salt is apt to be used in excess, to our physical detriment.

13. Purin-containing foods like tea, coffee, cocoa, beef tea, are occasionally the cause of headaches, rheumatism, and other maladies.

14. Many valuable foods contain poisons which must

be guarded against. Much of this may be due to idiosyncrasy.

15. The best arrangement of the meals is three each day, with an interval of five hours between breakfast and dinner, and six hours between dinner and supper.

16. All food should be well masticated, and not bolted or swallowed with draughts of fluid.

CHAPTER III.

DRINK.

LAW II.—"Drink from two to three pints of fluid each day."

ONE of the most common complaints heard from one's patients is that, even after a very good night's sleep, they awake in the morning feeling worn out and wretched and quite unfitted for their day's work. They often add that they feel much more exhausted in the morning than when they went to bed the previous night. Such people are inclined to be incredulous when they are told that their discomfort is entirely due to the fact that they drink too little fluid; but there is little doubt that in the great majority of these cases that is the explanation.

The human body is built up of countless millions of cells, each one of which is surrounded by a fluid medium —the blood—and the cells themselves are largely composed of water, for quite 60 per cent. of the human body consists of this element. These cells live by imbibing their nutriment from the blood and casting out their excreta or waste matter into it. Where too little fluid is supplied, the blood maintains a higher specific gravity and the poisonous waste products of tissue or cell change are only cast off very imperfectly. The body is

therefore poisoned by its own excretions, and it is not too much to say that the chief reason of this is because a sufficient amount of fluid has not been supplied to carry off in solution the waste matter the cells manufacture.

Now, there is no fluid known to chemists which can dissolve as many solid substances as water, which is indeed the best solvent in existence. If, therefore, a sufficient quantity be supplied, the whole process of nutrition is stimulated, because the paralysing effect of the toxic waste products is removed by their solution and consequent excretion by the kidneys, skin, bowels, or lungs. If, on the contrary, these toxic materials are allowed to accumulate in the body, all sorts of diseases will arise, of the nature of gout, "goutiness," rheumatism, or one of the ailments commonly supposed to be associated with "uric acid."

Gilman Thompson has well summarised the uses of water in the body somewhat as follows:—

(1) It is incorporated with the tissues.

(2) It is the chief ingredient of all the fluids of the body—maintaining their proper degree of dilution.

(3) It prevents friction by moistening the mucous and serous lining membranes.

(4) It distributes the food to the tissues and removes waste matters, through the fluid media of the blood and lymph.

(5) It distributes the body heat.

(6) It regulates the temperature by absorption and evaporation.

Deprivation of water means death to every living thing. Man can abstain from eating for weeks, and yet live; but without water he would die in a few days, and

6

be seriously indisposed in a few hours. On the other hand, excessive consumption of water or any fluid is apt to be followed by disagreeable symptoms of indigestion, loss of appetite, fulness, oppression, flatulence, vomiting, purging.

The Needful Allowance.

The quantity of water required per day will, of course, vary with the size of the individual, the nature of his labours and diet, the external temperature and the dryness of the air. It is pretty safe to state, however, that from two and a half to three pints—or five or six ordinary glasses—of water should be taken every day. This is in addition to the pint and a quarter, or twenty-five ounces, which is contained in our ordinary solid food, because on an average there is 50 per cent. of water in the so-called "solids" of our dietary.

It is perfectly certain that very few people take anything like this quantity of fluid each day, and even then it is mostly in the shape of tea, coffee, cocoa, or even alcohol. It may be asserted with absolute truth that no law of health is so frequently broken, or ignored, as that requiring the ingestion of a sufficient amount of fluid per day. If the above dictum is considered a counsel of perfection, as the majority will still adhere to their tea, coffee, or cocoa, then at least three tumblerfuls of water, in addition to the fluid taken in these beverages, should be consumed each day.

Some fruits and vegetables contain 90 to 95 per cent. of water, and hence fruitarians and vegetarians can be content with a good deal less than the amount indicated, but even they are better to take as much fluid as possible within the above limits.

It is a mistake to suppose that water is absorbed by the stomach, as very little enters the system in this way. Almost as soon as it is swallowed it begins to be

pumped out of the stomach into the commencement of the small bowel, and there it is rapidly taken up by the blood vessels of the portal system,—which drains the organs of digestion into the liver,—and by the lymphatics, and hence it comes that the liver is the first organ which receives a thorough washing out from the ingested water.

Although the stomach only absorbs a small quantity of water, it rapidly sucks up alcohol, the purins of meat extracts, and the essential principles of tea and coffee. Hence the rapid restorative or stimulating properties of these substances, and the quick temporary relief which follows their use in cases suited for their administration.

In health the bowel can each day absorb three or four pints of water in addition to the ordinary solid food, but in certain conditions of ill-health it is unable to do so, and diarrhœa is set up.

Hot or Cold Water.

Water varies in its effect on the stomach and other organs according to its temperature. A pint of cold water is expelled from the stomach in three-quarters of an hour; whereas with water at 130° F.—the proper temperature at which to drink hot water—less time will elapse before its expulsion. Cold water stimulates a flow of gastric juice, and hence would increase many dyspeptic conditions, especially those associated with acidity. It is also more inclined to act upon the kidneys, causing an increased flow of urine and having a tendency to dissolve gravel and gouty concretions in the kidneys and bladder.

Hot water, on the other hand, acts beneficially on the lining membrane of the stomach and ducts of the liver, relieving spasm of the muscular layer both in the stomach and bile ducts, and dissolving excess of mucus. Probably more of it is retained in the alimentary canal,

and hence it has a greater influence in the cure of constipation than cold water.

Absorption from the bowel takes place chiefly by the portal vein, and so the liver is subjected to a thorough washing out while the water is on its way to the hepatic vein, which carries all the blood from the liver into the general circulation. Having reached the blood, the water is then able to modify the secretions of all the organs, making them more fluid and capable of passing much more freely through the ducts. and glands. In particular, the secretions of the liver are fluidified, and for this reason not only are gall-stones most unlikely to form in the gall bladder of one who drinks a sufficiency of water, but even when they are formed the drinking of water is at least a necessary adjunct to their solution, if that be possible.

The drinking of hot water is unquestionably an important factor in the improvement of health and the prevention of disease. It exerts its favourable action by dissolving and removing from the body waste matter of all kinds, the retention of which would be liable to set up chronic rheumatic and gouty conditions. For this purpose it would be well if one pint and a half could be taken two hours, if possible, before breakfast, and another pint one hour before dinner and supper. As a rule, however, the busy man has to be content with a good deal less. It is an advantage if a little alkali, such as bicarbonate of soda and perhaps a little common salt, be added to the water, because most of the objectionable waste matters are acid, and the addition of the alkali assists in their solution. There is little doubt that whatever benefit is derived from the water treatment at a foreign or home Spa is due to the extra supply of bland or possibly detergent (purifying) fluid consumed,

coupled with the careful regimen and change of scene and air.

The less fluid that is taken at meal times the better will the digestion be, as there is a tendency to wash half-masticated food from the mouth into the stomach, and this is of course a reprehensible practice. Four or five ounces may be taken at the close of each meal, and in all circumstances it is much wiser to sip water than to take it at a draught.

The Action of the Kidneys.

In whatever way water gains an entrance to the body, whether by injection into the bowel or under the skin or by drinking, it enters the circulation and is carried to the various organs of excretion to be removed from the body with the waste matter it has dissolved. There is a continuous escape of water from the system, as much as four and a half pints passing out each day. From the kidney it is excreted as urine, which is water holding in solution the waste matters from the breaking up of proteins. From the lungs it is excreted as watery vapour holding in solution the waste matters of the breaking up of the carbohydrates. From the skin it passes off as perspiration and sebaceous matter containing some of the fats. From the bowel it is mingled with the fæces, which are the undissolved residue of the food and digestive juices and some fluids thrown off by the bowel wall. About 50 per cent. of the water we swallow is eliminated by the kidneys, 28 per cent. by the skin, 20 per cent. by the lungs, and 2 per cent. by the bowel.

The kidneys are two brownish masses deeply situated in the region of the back, one on each side of the vertebral column. They are in a much higher position than most people imagine, their posterior surface lying on the last two ribs and the muscles in the neighbour-

hood, the right being a little lower than the left. It is quite a fallacy to suppose that they are the seat of the very common backache or lumbago which is so frequently experienced by some people, and which is almost always located in the muscles or the binding tissue between the muscles and bones.

Doubtless, badly flushed kidneys are apt to cause a slight sense of weariness, heaviness, or discomfort in the loins, due to deposit of gravel in the ducts, and the remedy for this condition—namely, a more plentiful consumption of water—is self-evident. Severe pain in the back is, however, never in the kidney itself, and, if not in the muscles, is likely—especially if it be of an agonising character—to be in the ureter, *i.e.* the duct which conveys the urine from the kidney to the bladder. A stone passing down this tube is capable of setting up an acute, intermittent, lancinating or stabbing pain, shooting down into the groin, and only being relieved by opiates or by the discharge of the obstruction into the bladder.

All the important ingredients of urine are simply removed from the blood which circulates through the kidneys, and hence when they are diseased the body may be poisoned by the accumulation of the urinary constituents which the kidneys have failed to subtract. The blood does not part with its own protein constituents if the kidneys be healthy, but if egg albumin or peptones gain admission to the circulation they are quickly excreted by a healthy kidney.

The quantity of urine passed in twenty-four hours varies with the amount of blood passing through the kidney and the local or general pressure maintained. On a cold day the blood vessels of the skin contract and those of the kidney expand, and hence the amount of

urine is increased, the reverse happening on a warm day. Under the influence of fear or excitement, again, the blood vessels of the kidney are dilated and more urine is excreted. In kidney disease the blood pressure is usually high, and a great amount of urine is passed, whereas in the conditions which are surgically known as "shock" it is very low and the urine is scanty.

The amount of urine excreted depends also to a large extent on the amount of water drunk, and the rate of discharge will vary according to the position of the body and other circumstances. If two pints be drunk it should be excreted in the urine within three hours in the erect position, but in much less time if lying on the back in bed. In diabetes the great amount of water excreted is a rough index of the amount of sugar being expelled from the body.

If excess of animal food be eaten the urine is very acid, whereas on a vegetarian diet it has a tendency to be alkaline. Proteins are metabolised or broken up in the system into urea, uric acid, and ammonia. The amount of urea depends entirely on the amount of nitrogenous food ingested. The amount of uric acid depends upon:—

(1) The amount of purins—so-called "uric acid"—eaten in the food. This is called "exogenous" uric acid.

(2) The breaking down of the body tissues by exercise, etc. This is called "endogenous" uric acid.

(3) The absorption of acids formed from indigestion—which is probably the cause of much rheumatism in those who disobey the laws of health. The amount of ammonia depends on the quantity of acid entering the blood, and hence is greater on a meat diet.

It is a great mistake to suppose that drinking large quantities of water tends to produce corpulence. It has absolutely *per se* no power to produce fat, but if taken along with food it produces a more rapid and effective distribution of the nourishment, so that it is wise to restrict the amount of fluid taken at meal times in those who are inclined to obesity. But, meal times apart, many stout people drink much too little fluid, with the result that they are unable to eliminate their waste matter, which accumulates in the system much to their disadvantage. The true treatment of obesity consists in diminishing all the food, especially the carbohydrates, taking plenty of exercise, and drinking hot water copiously between meals.

Water may contain harmful substances, such as excess of mineral salts, or the micro-organisms of typhoid fever and cholera. Boiling will kill all the disease germs, and will throw down a portion of the mineral matter held in solution. It cannot, however, entirely free the fluid of all its deleterious ingredients, and hence, where it is suspected, distillation should always be resorted to. This is quite a simple process nowadays, when excellent stills may be obtained at a merely nominal cost. They require very little manipulation or attention, as they act almost in an automatic manner. Most of them are constructed so that the flat insipid taste of the distilled water is removed, but where this is not arranged for it can easily be made palatable by pouring from one glass into another or shaking it up in a large bottle to enable it to re-absorb the air which has been expelled.

The consumption of distilled water is a valuable agency in the prevention and amelioration of many ailments—chief of which are stone in the kidney and bladder, and goitre or "Derbyshire neck." When every

other remedy has failed, this latter disease is often cured by distilled water.

Filters should rarely be used, as they are seldom reliable.

There is no principle inherent in water which is capable of imparting to it any stimulating property, but Sir Lauder Brunton has pointed out that a wineglassful of cold water will produce a greater degree of stimulation of the heart, if it be sipped, than the same quantity of brandy swallowed with a gulp. This is due, however, to reflex action, and not to the nature of the fluid. Most of the other beverages consumed by man have, in addition to this solvent and diluent power, some other property, such as agreeable taste, or else they act as stimulants or pain-soothers. Mankind appears to have an inherent craving for something either to relieve fatigue or to make it less conscious, as such beverages are used both by civilised and uncivilised peoples.

How to drink Tea.

Tea is by far the most popular of these drinks, and its use as a beverage has been common among the Chinese from very early times. It was as late as 1657 that it was introduced into England at Garraway's Coffee House, and it was immediately received into great favour. Britain and her colonies still consume more tea per head than any other nation in the world, as statistics of fairly recent date clearly show. The annual consumption of tea per head of the population in France was shown to be 1 oz., Germany 2 oz., the United States 17 oz., Holland 24 oz., Canada 74 oz., the United Kingdom 98 oz., while the average for the last ten years in Australia reached 116·8 oz. or 7·3 lb. per head.

It is interesting to note how this bears comparison with the annual consumption of meat in pounds per

head. Australia is again at the top with 233 lb., Great Britain comes third with 109 lb., and Canada fourth with 90 lb. In this case the United States occupy second place with 150 lb. of meat per head. It may only be a coincidence that in these four countries there are more patent medicines sold—especially potions for dyspepsia and pills for constipation—than in all other countries in the world put together.

Tea is the dried and prepared leaf of Cammelia thea, a plant which is indigenous to the southern part of Asia. It is sold as green and black tea, the former containing much more tannin on account of its method of preparation for the market.

The chemical constituents of tea are very numerous, but tannin or tannic acid and caffeine or theine are the ingredients that are physiologically active. The flavour is determined by an essential or volatile oil. It is a remarkable fact that tea, coffee, and cocoa contain the same active principle, variously designated theine, caffeine, or theobromine according to its origin, but possessing the same chemical formula and action. Teas contain from 2 to 4 per cent. of caffeine and 14 to 25 per cent. of tannic acid, according to the district in which they are grown.

The refreshing and stimulating feeling experienced by tea-drinkers is due to the caffeine, and the deleterious effect so often produced on the digestive processes is due to the tannic acid. For this reason it is important to prepare tea for drinking purposes in such a way that it may contain the greatest quantity of caffeine with the minimum of tannic acid. Fortunately there is no difficulty in doing this, as the caffeine is rapidly extracted on the addition of boiling water, whereas the tannic acid is extracted more slowly. Practically all the caffeine

will be removed from the tea leaves by boiling water in five minutes, whereas it takes more than half an hour to remove all the tannic acid.

To obtain the greatest benefit and pleasure from a cup of tea boiling water should be poured over the leaves, allowed to stand for three to eight minutes according to the quality, and then poured off to be drunk immediately. The water should be fairly soft, quite fresh, and just brought to the boiling-point. The tea should be prepared in a warmed, closed, and covered vessel—and nothing beats the brown earthenware pot—and the fluid should not be allowed to boil whilst the infusion is going on. By this means the volatile oil, and therefore the flavour, as well as much of the stimulating property, is preserved, and the tannic acid and other objectionable extractives left in the leaf. Prolonged boiling or stewing destroys the volatile oil, and extracts more tannic acid, thus rendering the drink less palatable and more detrimental to the digestive system.

As there is no nourishment in tea, and it is often necessary to take every possible means to introduce nutriment into a patient, Sir Andrew Clarke suggested that boiling milk might be poured over the tea leaves and a maximum of caffeine with a minimum of tannic acid extracted in this way.

It is said that the Japanese make their tea with warm but not boiling water, pouring it on the leaves in a cup and drinking it almost at once. As by this means practically no tannic acid would be obtained and only a very small quantity of caffeine and volatile oil, an explanation is given of the reason why they can drink it all through the day with little, if any, detriment to their health. In England, where a similar custom is followed by many of the lower classes, who keep the tea

pot constantly stewing on the hob, anæmia, dyspepsia, and nervousness are common complaints.

A Debatable Habit.

The action of tea upon the system has produced much controversy. Some say it increases, whilst others say it diminishes, tissue waste. What is quite clear is that it is a gentle stimulant to the nervous system, is very refreshing, removes or relieves the sensation of fatigue, and thus allows of increased exertion without food. Its staying powers have been frequently tested by explorers and soldiers on the march. It promotes cheerfulness and a lively flow of ideas, relieves slight headache, quietens the circulation and stimulates the sweat glands in a greater degree than a similar quantity of hot water.

It has, however, a tendency to produce insomnia, and in large quantities slow digestion, and causes irritation and catarrh of the stomach, with the frequent accompaniment of flatulence and constipation. It has been claimed that its use is not followed by any depressant after-effects; but this would be entirely contrary to any conceivable definition of a stimulant, because reaction is always equal to the action produced.

Clouston says: "Its use in moderate quantity is not followed by any injurious reaction, and is not prejudicial to any of the functions of the body." It will be observed that this statement is very guarded, and that the whole question turns upon the definition of moderation. It is precisely here that the difficulty arises, and I have no hesitation in saying that, in common with all so-called stimulants, its use is much more frequently followed by chronic intoxication than is usually supposed. Sufferers from this ailment do not reel about the streets like those who are under the influence of alcohol, but they may display muscular tremor, irregular heart action, breathlessness, nervousness, headache, neuralgia, ringing

of the ears, accompanied by indigestion and constipation, and severe mental and physical depression.

It is doubtful to what particular ingredient these symptoms are to be ascribed, but most authors are inclined to set them down to the effect of the caffeine. It is a methyl-xanthin or purin, and allied to uric acid, so that theoretically it ought to bring about just such maladies as are induced by exogenous purins. However this may be, I have made many observations on people suffering from headache of a periodical nature, sometimes accompanied by sickness, at other times not, but always of that character so generally ascribed to the condition known as "uricacid-æmia." Where the patients refused to adopt a purin-free diet they were persuaded—as a compromise—to give up tea, coffee, and cocoa. In all the cases noted, after a preliminary exacerbation of the headache, it disappeared never to return, even although in six months' time small quantities of the beverages were resumed. Clearly, such headaches were due to the ingestion of a greater quantity of caffeine than the system could dispose of, but whenever the dose of the poison was reduced to the amount the body could tolerate the bad effects ceased.

Probably in headache the temporary relief obtained by drinking a cup of tea is due to the fact that caffeine quickly acts as a diuretic, and leads to an increased excretion of the nitrogenous elements, especially of urea and the fatigue products generally. This is only possible with moderate doses, because it has been experimentally demonstrated that, the greater the quantity of caffeine absorbed, the less in proportion is it metabolised, and hence it accumulates in the system and produces its toxic effects.

I am quite convinced that teetotallers are acting on

a mistaken notion when they imagine tea may be drunk with impunity, and that, instead of recommending it wholesale, they should institute an inquiry as to whether it may not be answerable for many of the lamentable lapses into inebriety so common among women of all classes to-day. Doubtless much depends upon personal idiosyncrasy, and there are many people who ought, in the interests of their health, to resist the seductions of the tea-pot. Those who possess a highly sensitive nervous system are much better without this beverage. It must also be avoided in all irritable conditions of the alimentary canal, in dyspepsia, in constipation, and nervousness or insomnia.

Many conditions other than these mentioned have been attributed to tea-drinking, such as multiple neuritis, and it has even been considered a contributory factor in producing insanity, although this is more likely to have been the result of the diminished quantity of nourishment usually taken by great tea-drinkers.

The fate of many professional tea-testers might be a sufficient demonstration that the above statements are not overdrawn.

Used in moderation, then, by the average person, tea ought to produce nothing but good results. It is best to confine its use to the meal usually called afternoon tea, and to sip two small teacupfuls with plenty of cream and as little sugar as possible. On account of the well-known effect it has of retarding the digestion of starchy foods, nothing should be eaten at this time. When tea is taken at breakfast it should be sipped after all the food has been eaten. It should never be taken after 5 p.m.

Coffee.

Coffee is the seed or bean of Coffea arabica, a small tree of Arabia and Abyssinia, now cultivated widely in tropical and warm climates. Like tea, coffee consists of

three important ingredients, caffeine, tannin, and a volatile oil with the addition of sugar, gum, and a little fat. In order to develop the flavour more perfectly, these beans are roasted, and the constituents are thereby altered. The sugar is converted into caramel, and the volatile substances collectively designated caffeone.

The active ingredients of coffee are caffeine and caffeone, and, although the chief effects produced on the body are due to the caffeine, still the cerebral stimulation and activity ensuing on a cup of coffee properly roasted are much greater than those produced by an infusion of raw coffee. As this latter contains the same quantity of caffeine, caffeone must be responsible for some of the stimulating effects of hot coffee. It must also be the source of the laxative property of coffee (caffeine being innocent of such an effect), and doubtless is the cause of the digestive symptoms associated with the excessive use of coffee as a beverage.

Dyspepsia is not induced so easily by coffee as by tea, although it causes dilatation of the abdominal blood vessels, producing a feeling of fulness in the abdomen, with a tendency to piles in some persons. The general action of coffee upon the system is wonderfully like that of tea, relieving fatigue and mental exhaustion, slowing and strengthening the heart's action and producing wakefulness and insomnia. It is said to diminish tissue waste and allow of increased exertion without the necessity for taking extra food.

The Caffeine Craving.

Civilisation has for so long depended upon the stimulus provided by tea and coffee, that it has been stated in some quarters that these drugs are essential articles of our diet. The mere fact that the greatest vigour of body and mind is compatible with complete abstinence from them should serve to controvert such an opinion. That*

it should prevail, however, rather lends support to my view that a large section of the community is under the influence of a caffeine craving. The truth of this contention can easily be demonstrated by almost any one who is bold enough to cease drinking tea and coffee for even a week. The unbearable headache which will torture his days and nights and the constant hankering after a cup of tea will soon convince him that he is under the spell of the drug. It will also be a wholesome reminder to some who have been in the habit of deriding the "craving" for alcohol.

An enormous amount of will-power is necessary to break off the habitual use of any drug, and tea and coffee are no exceptions to the rule. For, after all, every cupful of tea or coffee is equivalent to a dose of a drug, and not by any means an infinitesimal dose, but the full pharmacopœial allowance. Each cup of tea or coffee contains the equivalent of $2\frac{1}{2}$ grains of citrate of caffeine, a white drug kept on the shelves of every chemist in the world. I would commend this fact to the attention of the by no means inconsiderable section of people who are so loud in their denunciations of the medical man who occasionally allows himself to prescribe a "drug" of the more conventional category. A drug is a drug whether it be self-administered in sips from a china cup or gulped down from a nauseous bottle with or without a medical prescription.

There are many who are distinctly injured by the use of coffee as of tea. It should be eschewed by the highly nervous, by those who suffer from palpitation or almost any heart condition, by dyspeptics and bilious people, and it should never be given to children. On the other hand, there are many who find it most valuable and of great service in assisting them to combat constipation.

It may be stated generally that those who rely on tea and coffee as stimulants are laying up for themselves a store of trouble, as the reaction must be faced some day. Those, on the contrary, who partake of them chiefly as a pleasant means of flavouring water or milk will be in no danger of taking them so strong as to produce the physiological effect of caffeine and consequent damage to their bodies. Taken to excess—and this is always a relative term—nervous and gastric disturbances are certain to arise. These include giddiness, headache, tremors, insomnia, flatulence, loss of appetite, and biliousness.

To prepare coffee properly, the beans should be roasted and ground to a fine powder at the time they are required, as prolonged keeping causes them to deteriorate in value. Boiling water should be poured on the powder, and after a very few minutes poured off and drunk. If it be boiled too long it loses its aroma and takes up too large a proportion of tannic acid. It is safe to say that, if these instructions be followed and a bad result ensues, then adulteration with a foreign substance, *e.g.* peas, beans, acorns, chicory or caramel, has taken place.

Café-au-lait is prepared by milk being boiled with coffee, and in many cases after a short use produces "biliousness." Some fluid extracts of coffee are quite agreeable and palatable.

There is a custom amongst students and literary men of drinking coffee to induce wakefulness, in order that necessary work may be performed. This, of course, is a most unnatural proceeding, and, although it may be permissible, undue prolongation of the habit can only end in "nervous breakdown" or neurasthenia.

This beverage was introduced into Europe about a century before tea and coffee, and is obtained from the Cocoa.

7

seeds of Theobroma cacao. They break readily into halves called cocoa nibs. The chemical composition of cocoa is not constant. On an average it consists of 50 per cent. of fat, 13 per cent. of starch, a variable quantity of protein and woody fibre, and 1 to 3 per cent. of an active principle called theobromine.

In its physiological action on the human system theobromine is very similar to caffeine, but it is much weaker, and, as it occurs in extremely small quantities in the ordinary preparations of cocoa and chocolate, its effect may almost be disregarded. This may be the reason why the use of cocoa does not tend to produce wakefulness or muscular tremors, as tea and coffee do. Nor does the mind become so alert under the influence of cocoa, although it relieves the feeling of muscular exhaustion in much the same way as tea and coffee.

It likewise differs from these two beverages in that it possesses nutritious properties, which are chiefly due to the fat it contains. Although much of this is lost in the process of manufacture, a sufficient quantity remains to have a decided food value. Two teaspoonfuls of the powder are used to prepare a cupful of the beverage, and this will yield 40 calories. When prepared with milk and sugar it can be made to yield 400 calories, about one-sixth part of what is required in a day. It is therefore a valuable food in malnutrition when it can be digested. For, although it contains no tannic acid and is not liable to set up catarrh of the stomach or the nervous symptoms of tea and coffee, it is liable to cause indigestion on account of its contained fat and sugar. Those preparations, therefore, which contain the smallest amount of fat are to be preferred for dyspeptics, although, of course, their food value is much diminished by its extraction.

Flour, starch, arrowroot, alkalis, and various chemicals are sometimes added to cocoa for purposes of adulteration.

Chocolate is cocoa to which has been added sugar, with perhaps a little starch, and a flavouring agency, usually vanilla or cinnamon.

Food reformers and others who believe that the active principles of tea, coffee, and cocoa have in some way a toxic influence on the body have exercised their ingenuity in manufacturing many substitutes. These have nearly all the cardinal defect that they are frankly imitations of the three beverages named, and, as they are in every way poor substitutes, they are by no means popular. They chiefly consist of well-known grains such as wheat and barley, roasted and ground to resemble coffee.

Aerated waters are much in vogue for dietetic purposes. The carbonic acid in them stimulates the stomach, and they have a clean, sharp, and agreeable taste; but they are often unsuitable on account of their tendency to distend the stomach. They have the great advantage that well-known brands are free from microbic infection, and this is an important matter when travelling in a foreign country.

The Use of Intoxicants.

No subject has given rise to a greater amount of controversy than the physiological action of alcohol. A whole library of books has been written on the subject—most of them condemning its use both in health and disease in no unstinted terms, although some of them advance quite as much evidence in favour of its moderate and regular daily use. Perhaps this remarkable difference of opinion may be somewhat accounted for by the confusion between alcohol and alcohol-containing beverages.

No one in his senses would think of drinking absolute alcohol, and very few would even drink brandy or whisky

neat, which contain quite 50 per cent. of water. Clearly, the action of alcohol on the human body is vastly different with a 3 per cent. solution such as is found in Munich beer, and a 50 per cent. solution such as prevails in some spirituous liquors. It is doubtless true that the effect of an alcoholic beverage on man is deleterious in proportion to the strength of the alcohol it contains, but is modified in some degree by the other ingredients.

In the following short description of the physiological action of alcohol my remarks must be considered as referring in the main to alcohol the drug. For there can be little doubt that, in common with tea, coffee, and tobacco, alcohol is a drug, and only differs from them in one important characteristic—that, whereas they produce no structural alteration in the body, alcohol even in quite moderate doses has a tendency to cause degeneration or deterioration of the bodily tissues.

Alcohol and Health.

On all tissues with which it comes into contact alcohol acts as an irritant, and this may be considered the secret of its malign effects. It rapidly abstracts water from living matter and precipitates albumin. Hence, if held in the mouth for a few seconds, it turns the mucous membrane white and stimulates the secretion of an enormous quantity of watery saliva. This is a beneficial process—an effort of Nature to minimise its irritant effect.

The application of alcohol to the mucous membrane of the mouth produces by reflex action a stimulating effect, and when one wishes to obtain this without any of the after effects caused by its absorption into the system, it is only necessary to dip the finger into some whisky or brandy and water and rub it round the gums and inside the cheeks. In the stomach similar changes are brought about, the mucous membrane is congested

and an increased quantity of mucus secrcted, more gastric juice is formed, and the movements of the stomach are strengthened and quickened.

It has been claimed that alcohol in dietetic quantities shortens the time required for the digestion of a meal by half an hour, and this may be so, but it is known that 5 per cent. solutions retard, and 20 per cent. solutions stop digestion. Other medical authorities declare that two tablespoonfuls of brandy delay thc digestion of a meal in the stomach by half an hour. In any case, moderate amounts taken frequently, especially on an empty stomach, ultimatcly produce catarrh of this organ, which is the explanation of the morning sickness of the alcoholic.

In two minutes after being swallowed, alcohol reaches the blood, and in fifteen minutes its full effects are produced. Its action on the blood is threefold:—

(1) It forms a compound with the hæmoglobin, and thus causes that substance to part with its oxygen more slowly.
(2) It prevents the elimination of its waste matters.
(3) It paralyses the phagocytes—those friendly blood corpuscles which swallow all harmful germs—and so the body is laid more open to disease.

When it reaches the liver it dilates its blood vessels and causes it to be congested, the final result being thickening of the blood vessels, catarrh of the bilc ducts, and the growth of connective tissuc which presses upon and impedes the activity of the hepatic cells. This is the well-known cirrhosis or so-called "gin drinkcr's" liver. It dilates thc blood vessels of the skin and creates a feeling of warmth. On account of this action, however, a largc amount of heat is lost from the body,

so that the warming effect is purely fictitious, and in reality the temperature of the body is lowered. Hence the danger of taking alcohol in cold weather, as it only intensifies the depression of the vital processes.

Its claim to be a food is difficult to refute, because the facts are so contradictory. Two tablespoonfuls of absolute alcohol should yield as much heat by combustion as an ounce of butter, *i.e.* 200 calories, and it must be conceded that it is consumed in the body and therefore yields up heat and energy. This quantity of alcohol, which is said by such a good authority as Parkes to be capable of complete oxidation in the body in one day without producing any narcotic effects or any unchanged alcohol appearing in the urine, would be represented by 4 tablespoonfuls of brandy or whisky, 10 tablespoonfuls of port or sherry, 20 tablespoonfuls of claret, hock, or champagne, and 40 tablespoonfuls or 1 imperial pint of English beer or stout containing 5 per cent. of alcohol.

Dr. Hammond found that, when he was on an insufficient diet and was losing weight, the addition of a little alcohol enabled him to regain the loss. When we inquire into the explanation of these facts we find that, although on the one one hand alcohol creates a little heat, on the other it dissipates much more by transpiration from the skin, and by making the red blood corpuscles less efficient oxygen carriers. It creates a little energy, but it is proved by repeated experiments that less work is done by moderate drinkers than by total abstainers. Parkes' classical experiment of the two gangs of labourers, one of which was allowed beer and the other none, clearly demonstrated that less work could be done by the former than by the latter. The increase of weight is explained by the fact that it

prevents the combustion of fat, which is stored up in the tissues along with some of the waste products.

As it contains no nitrogen, it cannot possibly act as a means of building up the tissues, and instead of lessening it increases the waste of the tissues. Thus, although from the chemical point of view it may be claimed as a true food, it is not only a harmful one but a most expensive one. The combustion of a ten-pound note may give as much heat as the burning of a farthing rush-light, but we know which the wise would prefer.

The Abstainer's Advantage.

The experience of assurance companies has amply proved that the abstainer's life, from the business point of view, is better than that of the moderate drinker. The statistics of the United Kingdom Temperance and Provident Institution show that only sixty-five abstainers die for every hundred moderate drinkers—all carefully selected lives. For every thousand adult male deaths, one thousand six hundred and forty-two publicans and only five hundred and sixty abstainers die.

These facts are being recognised by the working man and by his employers in America, where the temperance agitation is a strictly business proposition. During the late financial depression the Burlington Railway Company gave orders to suspend the non-abstainers amongst their employés, regardless of their length of service. If an employé of the American Express Company is found drinking on duty he is discharged, and when he commits this offence off duty he is warned the first time and discharged the second time. In the North Western Railroad there are no less than forty thousand voluntary teetotallers.

In the last thirty or forty years the expenditure under medical direction on milk and alcohol has been

entirely reversed—the former being largely increased and the latter being almost extinguished. In surgery alcohol is only occasionally used as a temporary agency in shock. As a medicine it is being more rarely used every year, for it is known that even its therapeutic use is capable of causing disease.

The great Friendly Societies prefer a total abstainer, as he has only an average of six weeks' sickness as compared with eleven weeks for the moderate drinker. We now know that consumption and cancer are much more common among non-abstainers.

Alcohol is not really a stimulant but a narcotic, and ought to be classed with drugs like chloroform and ether, whose action is that of a temporary exhilarant with a long period of depression following after.

The Alcoholic Brain and Will.

The influence of alcohol on the moral nature is closely bound up with its effects on the general nervous system. Briefly, these are as follows:—

(1) A shrinking of the dendrites or feeler-like processes of the brain cells, with re-arrangement of their internal particles. These changes have been proved to occur in animals in fifteen minutes after swallowing a small dose of alcohol.

(2) A thickening of the coats of the blood vessels, causing them to obstruct the flow of blood, and hence of nutriment, to the nervous tissues.

(3) The growth of connective tissue pressing on and impeding the action of the brain cells. Precisely similar changes occur in the brains of the aged. Hence the effect of alcohol on the nervous system is to induce a condition of premature senile decay.

The higher functions of the brain, intellect, judgment, memory, will, self-control, and reason, which are the last to be developed in its evolution, are the first to show

signs of decay in accordance with the "Law of Dissolution." By degrees the drunkard loses complete control of his will-power, which is replaced by mere intention. Finally, the reasoning power becomes extinct, the body is guided by instinct, even the animal nature becomes debased and its lowest passions become predominant.

Twenty per cent. of all cases of insanity, and more than half of the cases of suicide, owe their origin to alcohol. Where the use of alcohol is prohibited the number of arrests for crime at once falls. During the recent terrible earthquake at San Francisco all places for the sale of alcohol were closed, and, despite the prevailing conditions of social anarchy, the average daily number of arrests for crime was only three. The very day the saloons were re-opened no less than seventy people were arrested, and this number was much increased on subsequent days.

Drink and Heredity.

It is a notable fact that only 10 per cent. of a drunkard's children are physically and mentally normal. In a recent investigation on this subject it was shown that of six hundred children, born of one hundred and twenty drunken mothers, three hundred and thirty-five were still-born or died "in infancy." Of the survivors, 4 per cent. were epileptic and many were mentally defective. The result of medical inspection in the schools of New York has revealed the fact that 53 per cent. of the children of alcoholic parents are "dullards," as compared with 10 per cent. of the children of abstainers. Researches on animals which had small quantities of alcohol administered in their food prove decisively that the hereditary factor in alcoholism is not imaginary.

With these facts before us it is hardly to be wondered

that the verdict of practically all medical men is that alcohol is unnecessary in health, and that those who are not possessed of strong self-control or who have a tendency to gout or any degenerative changes in their tissues are much better without it. Many people appear to be able to take it in moderation without harm, but, as they grow older most of them find they are not so well when they use it habitually, and either give it up or take it more rarely. The abuse of alcohol in any form is always followed by harmful results.

Most medical men would also agree that it is likewise useless in sickness, as equally potent substitutes can now be obtained. In every case in which it is prescribed in disease it should be looked upon as a medicine, and just as much care should be used in its dispensing as is usual with other drugs. These remarks apply particularly to whisky, brandy, gin, and rum, which are simply solutions of alcohol in water.

Wines are prepared by the fermentation of grape juice, and are composed of water, alcohol, acids, ether, sugar, extractives, and glycerine. Their influence on digestion is greater than can be accounted for by their contained alcohol. One per cent. of sherry in the stomach contents entirely stops digestion, a result which is probably due to the acid content. Despite this fact, the use of wines in small quantities often improves the appetite and stimulates the peristaltic action of the stomach. Their habitual use is apt to be followed by catarrh of the stomach, and to induce attacks of gout and rheumatism in those predisposed to them. Red wines, on account of their contained tannic acid, produce constipation.

Malt liquors contain from 3 to 8 per cent. of alcohol with a little sugar and dextrine. If justification can be found for the habitual use of alcohol in any form, it is in

the case of weak beer or wine and water. Even total abstainers who go to the Continent are struck with the air of content and happiness which characterises the family life there, and it will be found that almost invariably lager beer or claret and water is used as a beverage. Although a total abstainer, I have always made it a practice on Continental trips to partake of the delightful Munich or other lager beer, and have been inclined to ascribe to its use much of the beneficial effect of my holiday. I think that a factor in the solution of the intemperance problem in this country would be to allow the practice of free brewing and to pass a law decreeing that beer shall contain no more than 3 per cent. of alcohol.

The occasional use of alcohol as a medicine in a temporary indisposition is not likely to be harmful, and no one should be so fanatical as to object to it either in his own person or that of any one under his control or supervision.

Tobacco is now in such common use, especially after meals, as to be considered almost in the light of a dietetic agency. It is included in the British, German, and United States Pharmacopœias, and has powerful emetic and nauseating properties, acting in neurosis as a paralyser of the muscles of respiration and depressant of the action of the heart. Before the days of chloroform its use was counselled as an anæsthetic and pain-killing agency for surgical operations, but to-day it is only employed for smoking in pipes, cigars or cigarettes, chewing and snuffing. Tobacco.

Its moderate use is accompanied by a decreased necessity for food without loss of strength, as has been amply proved by soldiers and sailors. This is, of course, only a temporary effect, due to the sedative effects of

tobacco on the nervous system. If the expedient were persisted in for any length of time, weight and strength would both be lost, but there is ample proof to show that during periods of strain or deprivation of food it is able to postpone a breakdown. It has an undoubted value in stimulating the peristaltic action of the bowels, and many victims of constipation find the post-prandial pipe a sovereign remedy for their affliction. It is indulged in largely because of its sedative effects, which in those accustomed to its use are considerable.

Smoking is undoubtedly a habit acquired from the exercise of the imitative faculty in man, and from the fact that women rarely indulge in it and yet have longer lives than men and probably no fewer worries, it cannot be considered either necessary or conducive to longevity. Athletes in training generally avoid it, so that it is not a factor which contributes to increased health and strength. It is undoubtedly deleterious to many, especially to those with highly sensitive nervous systems. It is no uncommon thing for a few whiffs of a cigarette to produce giddiness, cold feet, and palpitation in such persons. It has been clearly established that it is prejudicial to the growth of young people, and it should never be used by those who have not attained their full strength and stature. As it is generally abused, it is more harmful than useful, and should never be indulged in by those who have not a good circulation.

It used to be considered that there was no nicotine in tobacco smoke, but it has been lately demonstrated that all the baneful effects of smoking are due to the absorption of nicotine. A person absorbs nicotine according to the extent of absorbent surface in contact with the column of smoke. Hence those who inhale cigarettes, and thereby add to the mouth, the mucous membrane of

the larynx, windpipe, and larger bronchial tubes, are exposing three times more surface for the absorption of nicotine, and suffer accordingly. Many a man can smoke one large strong cigar in the ordinary way without any bad result, whereas the inhalation of three cigarettes containing an infinitely smaller quantity of nicotine will produce nausea, giddiness, and palpitation.

There is no proof that smokers are more liable to cancer of the mouth, throat, and tongue than other people, but it is unquestionable that the use of a pipe which irritates the lips is conducive to the origin of cancer there.

Finally, nasal catarrh and throat irritation are much more common in smokers than amongst their fellows.

Practical Summary.

1. Two or three pints of fluid ought to be drunk each day. Neglect to do this often occasions insomnia and other troubles.

2. Water is the best fluid for drinking purposes, and five or six glasses should be taken each day. It is unwise to drink much at meal times, as the stomach cannot deal with fluid to any great extent.

3. Hot water is more easily tolerated by the stomach than cold water. It is also more valuable for relaxing spasm and cleansing the lining membrane of the alimentary canal.

4. A certain amount of the benefit derived from residence at a foreign Spa is due to the fluid consumed there.

5. Drinking large quantities of water has no influence *per se* on the deposition of fat. If taken at meal times, however, it causes a better distribution of the food particles, and hence in this way assists in producing obesity. It is better to be taken between meals.

6. Water may be rendered quite safe by boiling and quite pure by distillation.

7. Tea should always be made by pouring boiling water on the leaves, allowing it to stand for from three to eight minutes, then pouring off and drinking immediately.

8. The drinking of tea tends to promote cheerfulness, relieve slight headache, soothe the heart, and stimulates the secretion of sweat. It is liable to produce insomnia and dyspepsia.

9. Tea drinking in excess is always harmful, and is not free from the suspicion of encouraging the consumption of alcohol.

10. Coffee has much the same good and bad qualities as tea.

11. Cocoa possesses some nutrient properties, is less apt to produce indigestion, and is not so liable to cause wakefulness.

12. Alcohol, like tea, coffee, and cocoa, is a drug, but unlike them its consumption has a tendency to produce tissue degeneration.

13. Alcohol is unnecessary in health, and although from the chemical point of view it may be claimed as a true food, it is not only an expensive but highly dangerous one.

14. It is being daily less used in the treatment of disease, because it is recognised that it is more likely to produce disease than cause its amelioration.

15. Tobacco depresses the heart, weakens the muscular system, and is prejudicial to the growth of young people.

CHAPTER IV

WORK.

LAW III.—"Regular work both of body and mind, to the full capacity of the individual, is the best safeguard against disease."

The Unresting Body.

IT is much to be feared that the popular ideal is that of a life of pleasure and ease, and not one of work and service. We are inclined to look upon work as a necessary evil, and work hard in order that we may gain the means to retire and so rid ourselves of all future work. We fail to realise the meaning of work or the nobility attached to it, and rarely dissociate it from the pelf that labour brings. We recognise that disuse of machinery causes it to rust, but do not stop to think that disuse of any of the bodily organs quickly brings on disease.

In all this we are strangely at variance with the cells of our body tissues, which are the seat of constant change—a change due to the fact that the living frame is incessantly at work. We are familiar with the fact that during life the heart never ceases to beat, the respiratory muscles to perform their beneficent purpose, the digestive organs to manufacture their fluids and secretions, and the brain and nerve centres to supervise and energise the actions through which life is maintained.

Few of us are, however, conversant with the intimate changes which take place in the cells of our tissues, and which in some sort never cease from birth till death. The name which has been applied by the scientist to these ultimate life processes is Metabolism—a word compounded of two Greek words meaning "to throw beyond," but whose significance may shortly be explained as an exchange of material. It refers to the process by which on the one hand the dead food is built up into living matter, and by which on the other-hand the living matter is broken down into simpler products within the cells of the tissues; and it covers the whole ground from the entry of food and drink into the mouth, and air into the lungs, till their excretion by the skin, lungs, kidneys, liver, and bowels. It is, however, usual to confine the word to the actual changes between the blood and the ultimate elements of the tissues.

The cells are composed of a plastic living substance called protoplasm—or bioplasm—and each one is surrounded by a minute lymph or capillary blood vessel. The cell, by a process of imbibition, takes up oxygen and nutriment from the blood and incorporates them into its own substance by a process spoken of as Anabolism.

The blood not only contains the fuel, but is the circulating medium both for the income and expenditure of the tissues. There are many methods whereby we may increase a banking account. The banker will convert cheques, postal notes, cash, bonds, bills, scrip, and other well-known forms of security into liquid assets, the raw material of which is the recognised circulating medium of the financial world. In a similar way the varied and bulky ingredients of the bodily income, the proteins, the fats, the carbohydrates, the salts, water and

oxygen, are converted into the blood, which become the liquid asset of the body.

The Secret of the Cell.

It is an inscrutable mystery how each cell of each separate organ is able to take from the blood practically the same substance, in the proper proportions, and yet be able to convert them into its own peculiar substance, so that in one case brain tissue, in another bone, in another muscle, in another nerve tissue is formed. It is a matter of everyday observation that some plants will grow on one soil and other plants on a different kind of soil; but here is a case in which from the same soil, the same nutrient fluid, the most diverse structures are capable of being formed. It is no less wonderful that from the blood, secreting glands whose cells are to all intents and purposes similar, should evolve such varied products as tears, milk, saliva, etc. Doubtless, when an explanation of these processes is possible, the secret of life will have been solved.

The combustion which takes place in the tissue cells produces heat and energy, and waste products are thrown off into the blood in the shape of water, carbonic acid, and nitrogenous products, to be disposed of by the various organs of excretion. There is thus a double process involved in metabolism:—

(1) Building up of the bioplasm or assimilation, technically called Anabolism.

(2) Breaking down of the bioplasm or dis-assimilation, technically called Katabolism.

If these exactly balance each other, then equilibrium takes place—a happy condition only known in careful-living people. We say a happy condition, because, when equilibrium is established, no energy is wasted in digesting more food than is required, and no clogging of the system results in storing up fat which is not necessary.

When assimilation is in excess, then fat is laid on; when dis-assimilation takes place in excess, then fat and flesh are lost.

This is a simple account of the waste and repair of the tissues. The mind may be able to picture the actual state of affairs by comparing the tissues to a brick wall, each cell having its analogue in a brick and the spaces filled with mortar being comparable to the capillaries. After a few years' wear it will be noticed that here and there a brick is so worn out that to preserve the integrity of the wall it has to be replaced, and again in a few years the same process takes place until, in course of time, the whole wall may thus come to be renewed in its entirety. Now, one can imagine a similar process taking place in the cells of the tissues. Instead of isolated cells being worn out, all the cells are equally affected, and instead of the replacement occurring after the lapse of years, there is no actual replacing at all, but a daily repair of the damage to each cell, so that in health the tissue never looks patchy but is always homogeneous.

This fairly represents the ceaseless working operations of the body tissues. It is easy to understand that when the daily waste is a little more than the powers are able to repair, before long exhaustion must take place and a breakdown is imminent. Fortunately, the functions are able to cope with a good deal more than is just able to make up for the wear and tear, so that in natural conditions such a breakdown is seldom brought about. In the unnatural life of a city the conditions are quite different, and it is not surprising to meet with so many cases of nervous exhaustion, or so-called neurasthenia. This also explains how in cases of nervous breakdown the "tonic" which the public constantly demand is so seldom useful, and how a complete renovation of the

whole body is necessary. In other words, there is no royal road to cure, though there may be short cuts which will slightly diminish the length of the journey.

It is said that about one twenty-fourth part of the body wastes daily, so that in about three weeks our whole tissues are reproduced, and yet our personality is wondrously retained throughout the change.

So far we have only been considering the internal operations of the human engine, and have ignored its capacity for doing work as it is generally understood. No sane man keeps an engine for the mere pleasure of watching its manifold and intricate mechanism in motion. He demands in addition that it should subserve some useful practical purpose. In like manner the human body exists for some other purpose than simply to exhibit its wonderful anatomy and physiology. To justify its existence it must be capable of doing some useful work in the community, and to this end it has been endowed with a desire to live and evade extermination. This is the physiological basis of all the work of a human being, and from it is evolved the necessity to "energise," for the cells of the tissues must transform their contents into energy of some sort for good or evil. The Physical Engine.

There are thus two forms of work performed by the human body:—

(1) Internal work, which enables it to exist, *e.g.* the beating of the heart, the movements of respiration, the digestion of food, etc.

(2) External work, which is that expended by the muscles in locomotion, in the day's labours and all the voluntary movements of the body.

The two combined constitute the total power which the human engine is capable of developing on the fuel,

i.e. the food, with which it is supplied. This is usually measured by the number of pounds or tons which can be lifted through a certain number of feet. It is calculated that to provide for its own existence by keeping the circulation, respiration, and digestion in working order, and incidentally maintaining the temperature at 98°·4 F., no less than 2800 foot-tons of energy are expended each day. In other words, if employed to work an elevator, this amount of work would raise a weight of 2800 tons one foot high.

Computed on the same basis, the external work would amount to 300 foot-tons daily, although an energetic worker could develop almost double this amount. But in order to get this done, about five times more energy requires to be developed beyond that needed for the internal work. This, of course, means that no external work can be done without an increase in the beating of the heart, the number and depth of respirations, and the supply of food. The man, therefore, who produces 300 foot-tons of labour per day must actually provide 1500 foot-tons in addition to the 2800 required for the body's own affairs. This means that he generates altogether 4300 foot-tons of energy. When compared with the best steam engine in existence, which is only able to develop 15 per cent. of its energy into actual work, the rest being dissipated in heat, this shows an advantage of quite 5 per cent.

Although this displays an economy in force, human labour is not really as cheap as that of the steam engine, chiefly because food is much more expensive than coal. Besides this, however, the larger part of a man's earnings are necessarily spent in keeping his machine alive, depreciation and upkeep being daily debited to his revenue account. For all that, it is very noteworthy

that on a daily consumption of eight pounds of food, water, and air, the average man can produce work with greater economy than the best engines of his own invention. As might be expected, training still further improves the working output, and it has been proved in an Alpine ascent that whereas an untrained city tourist expended 449 calories in work and 1000 calories in heat, a trained carrier expended 884 calories in work and only 565 in heat.

Varieties of Fuel.

In these circumstances it is very important to be able to select the best foods in the proper proportions to produce the best results, not only for the production of energy but also for the repair of the living machine. If these be supplied in appropriate quantity and quality, then the working of the body goes on without friction, and produces no inconvenient by-products to clog the working parts, and the body is enabled to retain that elasticity and resiliency which are the prerogatives of health. To use a part properly is to keep it in the best working order.

All the power the body develops it derives from its food, and we speak of "body-building foods" and "energy-producing foods." These, however, are loose and artificial terms, as energy may be produced from protein, which is the typical body-building food; and fat, which is the product of starchy, sugary, or fatty foods (energy-producers) is actually built into the body substance.

By means of a calorimeter or heat measurer it is possible to calculate the amount of work which can be done on different foods and the body's working capacity viewed as a whole. As we have already seen, the proteins contribute to the tissue formation and repair, and the fats, sugars, and starches are the main source of energy and heat. It is calculated that 100 parts of

fat are equal in value as energy-producing material to 232 parts of starch, 234 parts of cane sugar, and 213 parts of protein, or 245 parts of flesh.

It is very interesting to study the actual changes which take place in each of the food elements in its passage through the body. During starvation it is noted that the fat and muscles suffer first, and the heart and nervous system least and last. Strong men die when they lose two-fifths of their body weight, young people die much sooner, although, if water be supplied, both will last much longer. Cold-blooded live longer than warm-blooded animals, snakes living half a year, and frogs living a year without food. The excretion of nitrogenous material is much diminished as compared with the carbon output, showing that the fats are being used up first, and the proteins not being interfered with till these have been consumed. All this shows how careful nature is to conserve the vital parts of the body even in days of stress.

On a purely flesh diet man cannot live for long. Lean beef contains 1 part of nitrogenous to a little over 1½ part of non-nitrogenous constituents. A healthy person excretes 380 grms. (12½ oz.) of carbonic acid in expired air, urine, and fæces, and to replace this amount at least 4½ lb. of beef would need to be digested and assimilated in twenty-four hours. To many people this would be an absolute impossibility even for one day, but in any case the strongest digestion would soon give way under it. Thereafter less beef would be taken, the fat of the body would soon be used up, and ultimately, as digestion failed still more, the proteins of the tissues themselves would be drawn upon.

It is an interesting fact that the usual type of a perfect food is of animal origin, *e.g.* milk, but few men

would have the courage to tackle the 8 or 9 pints necessary to supply the requisite amount of daily protein. If beans, peas, or lentils were selected, as they contain on an average 22 per cent. protein and 55 per cent. of carbohydrates and fats, it would be theoretically possible to maintain life on them, but the monotony of the diet would militate against a lengthened experiment. In the vegetable kingdom all the highly nitrogenous foods contain large quantities of carbohydrates as well, so that it would be possible to do better on the fleshless system if one were compelled to select only one article of diet.

Even a carnivorous animal can only live on a pure flesh diet free from fat, provided it is very muscular and pretty fat itself. Even then it requires to eat one-twentieth part of its body weight of flesh daily. If a dog be fed on lean meat it gradually uses up its own fat and succumbs. Thus dogs cannot live on a pure flesh diet, as their digestion soon fails. Probably no animal is purely carnivorous, but is compelled to have recourse to the vegetable world for some of its supplies. In any case, for purposes of health the carnivorous animal must eat not only the flesh but the fat, the bones and indeed the whole carcase of its victim. It is interesting to note that when a carnivorous animal is being put in training to do steady work, animal food is entirely cut out of its dietary. Thus when beagles are about to start their cross-country work they cease eating flesh and live on cereal foods during all the time they are undergoing their hard work, for only thus can they keep fit and capable of exertion.

The Disposition of Food.

Vegetable proteins are more easily digested by some people than animal proteins. Sir William Roberts pointed out that "milk is much more easily digested

by pancreatic extract than by artificial gastric juice; but in the case of egg albumin the advantage is entirely with the gastric juice." All flesh foods and eggs are more easily digested in the stomach, *i.e.* in an acid medium, whereas vegetable albumin and milk proteins are more easily digested in the small bowel, *i.e.* in an alkaline medium. When the proteins of the food are brought into solution, their molecules are split up in the intestine into fine fragments, mostly amino-acids. These are absorbed through the bowel wall and reconverted into specific body protein, much in the same way as a banker converts a cheque into cash and then again into a cheque if so required.

Protein metabolism depends chiefly on the amount of protein which is swallowed, and, as regards this quantity, there is much difference of opinion. Chittenden asserts that 0·85 of a gramme per kilogramme of body weight, or about 6 grains to the pound, are all that is necessary, whereas Haig believes that health cannot be maintained on less than 9 grains per pound of body weight. It is quite certain that health and nitrogen equilibrium can be maintained on varying quantities of protein, and perhaps some of the different views may be reconciled when it is remembered that substances like gelatine, practically banned by Haig, may be used to spare the protein consumption.

In vegetable foods carbohydrates and protein are so intimately mixed that it is possible to maintain nitrogen equilibrium more easily on a vegetarian diet than on any other. The protein molecule is split up in the tissues into its nitrogenous and non-nitrogenous portions, and, as this latter could easily have been replaced by carbohydrate or fat, it is for all practical purposes wasted. This is the contention of those who declare that the

ordinary three and a half ounce protein standard is too high. They declare that a little more than half this quantity is to be preferred, because the excess entails greater work upon the organs of excretion. Their aim is to use protein only, or mainly as a repairing agency.

On a diet of pure fat an animal can only live for a very short time, dying even more quickly than when allowed to starve, because the fat interferes with the metabolism of the proteins. When used as a part of a normal diet, however, its assimilation is a much simpler matter than that of protein. In the process of digestion, fat is split into fatty acids and glycerine, which, upon being absorbed by the cells of the small intestine, are immediately reconverted into fat and reach the blood through the lymphatics. It is not then built up into the cell substance like protein, but deposited in the connective or binding tissue, and hence it is very similar in appearance and consistence to the fat used in the food. It is well known that cod liver oil is a rapid fattening agency, but when its administration ceases the adipose tissue formed is quickly dissipated. Mutton fat, on the other hand, is firm and solid, and, when used as a dietetic agency by consumptives, is a progenitor of a much firmer and more lasting adipose tissue. It is more easily assimilated when taken in hot milk.

On a purely carbohydrate diet death occurs much more rapidly than even on fats, as it is much more easily oxidised and got rid of. All carbohydrates are converted into glucose or grape sugar by the processes of digestion, and, when absorbed by the cells of the intestinal wall into the blood, they cannot be identified again. We know that sugar reaches the liver and is there converted into glycogen, a normal liver containing about 10 oz. and the muscles rather less. It is supposed that glycogen

is reconverted into sugar, and in that form conveyed to the tissues where it is utilised.

If the tissue cells fail to burn up the sugar, then it is excreted in the urine and the disease called diabetes or at least glycosuria is established. There is reason at the same time to believe that this simple explanation is not exhaustive, and that diabetes is dependent on a much more complex pathological process. It is known, for example, that only certain sugars can be converted into glycogen and that some of the sugars contained in fruit are directly excreted by the kidneys unchanged. Hence sugar may appear in the urine of those who freely eat of certain fruits.

The needful Combination.

It is thus evident that the tissues cannot work for long on any one of the alimentary principles, for we know that man cannot live on water alone, or salts alone. In other words, the nutrition of the body demands a combination of two or more of these food principles. Of these, protein must always be one. It is possible to live on protein and fat, or protein and carbohydrate, but it is not possible to live on fat and carbohydrate.

Protein is the body-building principle, and if too little of it be taken then the protein of the body tissues is slowly consumed. If, on the other hand, too much be taken, one of two results will happen, depending upon the quantity of fats and carbohydrates ingested at the same time. If a large supply of these be taken, then fat is laid on; but if they are kept at a minimum, then the whole metabolism of the body is increased and stored fat is rapidly burned up.

It will be seen that the body can store up fat by itself and carbohydrates in the form of glycogen in the liver and muscles, but it is unable to store up any

appreciable quantity of protein. It is noteworthy, however, that when muscular work is increased there is an increased consumption of all the alimentary principles. More protein is needed, even although all agree that muscular work does not increase the destruction of that substance in the body, and, as exercise causes development of the muscles, it is reasonable to assume that the extra protein goes to build up the muscular tissue. There is a limit, however, to the increase of exertion, and when this has been reached and nitrogen equilibrium has taken place it would be wisdom to ascertain the quantity consumed in the food and adhere to it as closely as possible. The evils of an excessive amount of protein are pretty well known, and have been painted in very strong colours by the advocates of the low protein theory. That it must mean a useless expenditure of the most expensive form of food all will admit. No adequate proof, however, has yet been advanced that the extra work thrown on the organs of excretion, like the liver, kidneys, and bowel, actually induces disease in them. It is quite possible, nay probable, that this happens, but it does not amount to a certainty, for there are many people who for some reason or other have had one kidney excised and in whom the other kidney discharges the double function with ease and comfort. As for the contention that the surplus protein is in the colon the prey of proteolytic bacteria and thereby produces such poisonous products, as indol, skatol, phenol, leucin, tyrosin, muscarin, etc., which being absorbed promptly induce auto-intoxication with such symptoms as headache, etc., we can only point to the thousands of people who have lived on the standard hundred or more grammes of protein, and who never had a headache in their lives. Doubtless the

sedentary worker is wise to reduce his protein to the lowest possible limit, but he should not adhere to any arbitrary basis, but depend on instinct and experience as his guides.

Sources of Obesity.

Fat is stored in the body as a reserve of energy-producing material and as a means of diminishing the loss of heat. It is formed from the fat and carbohydrates, and probably also from the protein. At first sight it might appear that, whenever there is an excess of nourishment consumed, the surplus should be laid down as fat, much in the same way that a banking account grows when more money is paid in than is drawn out. But the problem is not nearly so simple as that, since we all know people who never appear to be able to become plump, no matter how much they eat. There are also cases in which the converse is true, namely, fat people who eat apparently less than their size or weight would warrant, and yet who continue to grow fatter.

Fat is deposited in the tissues, under the skin, on the abdominal walls, between the muscular fibres, and on many of the internal organs. It appears last on the abdominal walls, and, when required to manufacture energy, disappears from this region in the first instance. Doubtless, in days when the supply of food was precarious, it was advisable to have a reserve of energy-producing material in the shape of fat, but to-day it is only an incubus, restricting activity and impeding both the external and internal work of the body.

Despite what has been said, it may be set down as a general rule that most corpulent people eat more, both absolutely and relatively, than spare people. When, however, they are so excessively corpulent that they

are unable to take exercise or even to breathe freely, then, doubtless, a quantity of nutriment less than their normal will suffice still further to increase their stores of fat. It is in these circumstances that one so often hears the pathetic statement from the stout person that he cannot imagine how he manages to exist at all, as he eats so very little.

Now, a banking account can only increase by one of two methods—by adding something and taking nothing away, or by taking away less than is added. Likewise a person can only grow stout by one of two methods—by eating a little more than is absolutely necessary, or by exercising so little that the expenditure of energy in the form of work is much less than the income in the shape of food and drink. Doubtless both methods are in operation in most cases, and it is well to remember that quite 40 per cent. of obese people inherit the tendency, which is an additional reason for extreme caution in feeding. If the fat person would only think how little is acquired each day to make the difference between laying on flesh and standing still in that regard, he would hardly wonder at his daily growing proportions. Half an ounce per day means a quarter of a pound per week—a pound per month—a stone per year. It is no unusual thing under proper conditions to put on one pound per day and to keep this up for quite a number of weeks.

In the vast majority of cases the trouble is to be attributed to the afternoon tea with its half pint or so of hot fatty saccharine solution in the shape of tea, coffee, or cocoa, and its sweet cake or bread and butter and preserves. This meal is always superfluous to the person who partakes of three meals per day, and at the best is only a time for the imbibition of fluid. It

is altogether too seductive to the man inclined to avoirdupois.

The factors favouring obesity are:—

(1) Increased income. An excess of food in the form of a sufficiency of protein with an abundance of fats and carbohydrates. The best example of this is to be seen in the butcher who freely partakes of the ample supply of highly nitrogenous food which is always at his hand. It is rare to find a thin butcher or one free from gout.

(2) Diminished expenditure, or inadequate breaking down of the materials within the body in some shape or form:—

- (*a*) Diminished muscular activity. Hence the man who sleeps much and takes too little exercise gets fat.
- (*b*) Diminished mental activity. Hence the man of phlegmatic temperament is likely to become stout.
- (*c*) Diminished respiratory activity. Hence the fat man tends to become more fat, because fat on the abdomen lessens the movement of the diaphragm and increases the adipose tissue.
- (*d*) Diminished number of red blood corpuscles. Hence the anæmic person tends to adiposity, because oxidation is less than normal.
- (*e*) The consumption of alcohol causes the accumulation of fat in two ways:—(1) Because, being easily burnt up, it saves the fat in the tissues. (2) Because it causes fatty degeneration by paralysing the activity of the cells.

(*f*) A fat man should use much less heat-forming food than a thin man, because the latter gives off more heat from his compact body, and an accumulation of fat prevents the conduction of heat.

(*g*) The diminution of any other item of expenditure, emotional or otherwise.

The Cure of Corpulence.

The cure of obesity is not such a simple procedure as might appear at first sight. One might think that an entire reversal of the factors inducing obesity would be calculated to cure it, but there are many points to be taken into consideration which modify the treatment of any individual case. If we are dealing with a vigorous person whose organs are sound, the following rules should be adopted:—

(1) Reduce the total quantity of daily food. Whatever else be done, this is absolutely necessary, and one has a choice of various methods. As fat may be formed from all three alimentary principles, it may be sufficient to reduce each one. It is wise to estimate what the patient's weight ought to be, and then to give him a little less than his due allowance of protein, at the same time cutting down the fats and carbohydrates considerably. With a view to stimulating metabolism and thus inducing the more rapid combustion of the deposit of fat, an increased amount of protein (say 5½ oz.) may be allowed, with 1 oz. of fat and 3 oz. of carbohydrates. If regular exercise be taken with this diet, the fat is displaced from between the muscular fibres, and increased muscular tissue is formed on account of the extra allowance of protein.

Other methods in vogue increase very largely the allowance of protein, *e.g.* the Salisbury diet has been advocated, which consists of 3 lb. of rump steak

with 1 lb. of cod fish daily, together with 6 pints of hot water. The Banting system allows 1 lb. of lean meat per day with about 4 oz. of carbohydrates and the smallest possible quantity of fat. These three methods may be very useful in an occasional case, but they are not altogether free from danger, as they throw such an enormous labour on the kidneys in excreting the excessive nitrogenous waste which is formed. Each case must be treated on its merits, and after due consideration of all the facts.

(2) The patient should be weighed weekly, and the reduction should be slow and gradual.

(3) No fluid should be taken at meal times, as lack of fluid reduces the absorptive power of the alimentary canal. An abundant supply of fluid may be partaken of two hours after a meal.

(4) Both mind and body should be exercised freely, and it is important to exercise all the muscles of the body as far as possible and to continue the exertion until free perspiration takes place.

(5) The loss of heat should be increased by cold baths and friction, light clothing and bed-clothing.

(6) Acid fruits and gentle laxatives should be taken regularly.

(7) Hill climbing should be especially practised.

Where, however, we are dealing with a patient who has a weak heart and indifferent powers of exertion, we must adopt a different policy, and this should be in all cases left to the discretion of the medical attendant. A system which is much practised nowadays is to put the patient on an exclusive milk diet, the quantity of milk being severely limited. The patient must be entirely confined to bed, and as little as two or three pints of milk may be taken daily for months at a stretch.

The Excessively Thin.

A much more difficult problem is that of inducing thin people to become fatter. Frequently the only method of value is to put them to bed and subject them to a system of forced feeding, as much as 4 lb. of food and 3 pints of hot milk being consumed each day for two or three months. If an indiarubber bottle half full of boiling water be applied to the gastric region every two hours night and day, it is astonishing how easily this abnormal quantity of food can be tolerated. This system is especially applicable in the case of those highly strung people who, by reason of a hypersensitive or irritable nervous system, are always on the fidget or constantly performing superfluous movements. Instead of their muscles being in a condition of relaxation or moderate "tone" when inactive, they are tuned up to a very high pitch, and are therefore always consuming energy. In the average case, however, the following rules may be followed with advantage:—

(1) The amount of food should be increased compatibly with the powers of digestion, especially fatty food, milk, cream, potatoes, puddings, butter, honey, and nuts.

(2) Fluid should be taken with or at the close of each meal.

(3) Exercise should be taken to the point of getting warm.

(4) Thin people should never worry or care violently for any one.

(5) Warm clothing should always be worn. Plenty of sleep should be indulged in under warm bed-clothing. Warm baths should be taken instead of cold, and hot milk substituted for tea and coffee.

(6) Sweet fruits, figs, dates, raisins, apples, with sugar and cream, should be eaten instead of acid fruits.

(7) Thin people should keep to the level and avoid climbing hills.

The Essence of Health.

The effective nature of this exchange of material between the blood on the one hand and the bodily tissues on the other is mainly responsible for health. Chronic ill-health, on the other hand, is almost always due to ineffective exchange of material or diminished metabolism. If, for any reason, a sufficient quantity of nutriment cannot be taken up by the cells, or if they are unable to rid themselves of their waste matter, then the result will be diminished vitality, due to lack of working efficiency of the tissues. In these circumstances means must be adopted for an improved working capacity of the tissue cells, and it will be found in the main that this may be effected by the adoption of the laws of health inculcated in this book, modified, of course, to suit individual needs.

Probably the factor of greatest importance in this connection is an increase in the external work of the body, and for this reason exercise in the fresh air is extolled as a prime remedy against the incidence of disease. The valuable effects of exercise will be discussed in a separate chapter. For our present purpose it is sufficient to state that the result of muscular work is to increase very greatly the output of energy and the caloric value of the food ingested. A man at rest in bed will only expend an amount of energy equal in food value to 2000 calories, whereas severe muscular exercise may demand as much as 4000 calories. We have already shown that it is possible for a man confined to bed to subsist on about 3 pints of milk for a limited period, the total turnover of energy here being no more than 1200 calories. If he is allowed to walk about the bedroom, at least 10 per cent. more energy will be expended.

Hutchison quotes many interesting cases, chiefly from German authorities. Twelve per cent. more energy is expended when standing at attention than when standing at ease. An hour's saunter consumes 137 calories—equal to ½ oz. of fat—while an hour's quick walk doubles the output. A walk of four miles increases the expenditure of the body by about 275 calories, which could be covered by the consumption of 1 oz. of fat. Climbing expends twenty times more energy than walking on the level, *i.e.* to climb a mile per day is equivalent to walking twenty miles. To walk against a strong wind for a mile will expend an amount of energy which would have raised the pedestrian 8202 feet at a cost of 1200 calories (about 4½ oz. of fat).

Increasing the external work of the body, therefore, enormously increases the internal work, stimulates the income of nutriment and the loss of waste matters, which, being retained, would have helped to poison the tissues and lead to ill-health.

The Gospel of Work.

We have already seen that excess of adipose tissue is laid down in those who eat too much or work their muscles too little, and this in the great majority of cases is a vote of censure on the individual. It is possible that feeble vitality of the cells may explain the greater tendency to obesity in some families than others, but even in these cases increased work would have increased the exchange of material and helped to prevent the accumulation of fat. Man was made for activity, as the study of metabolism has demonstrated, and if he refuses to obey Nature's injunction he must pay the penalty by diminished health both of body and mind.

The first condition of good health is a life made fruitful by toil and ennobled by good actions. For

honest employment not only trains the body and mind, but develops the character. The continual use of a part creates a greater demand for good blood and therefore nutriment to repair the waste, and this constant interchange makes for physical perfection. But we shall see later on that the same laws govern the nervous tissues, and hence the mental and the moral nature are likewise improved by the habit of work. It is not too much to say that work must have a place in every scheme for the amelioration of the people. Prosperity is the natural reward of industrious labour, and a man's self-respect is thereby immensely enhanced.

Laziness is at the root of most failures. One hears much nowadays of the inviolable right of man to work, but the cry usually emanates from those who do not think it is right to work at all. Earnest serious diligence will always succeed, despite the self-pitying wailing of the indolent man. Work must be looked upon as a duty, and, if this be the case, much mischief both of body and mind will be avoided. The increase of wealth in the present day has made it possible for many to live without actually labouring with their hands or engaging in any kind of work at all. In these circumstances most healthy minded men seek out some form of open-air exercise, failing a more directly productive occupation, and play or work at it as a pastime—literally to pass the time.

Degradation always follows idleness. The moral character of the inhabitants of most hot countries is rarely on the high level of that of people living in temperate climates. Their bodies are emasculated and enervated, and, having no spur to progress, their moral nature is deficient. Too many of the people of our own country engage in a diligent quest after pleasure, and are

always on the search for some new excitement. Too much pleasure is infinitely more exhausting than work, and never succeeds in the attainment of happiness, which always proceeds from within. The sooner a man learns to take pleasure in his daily work the better, and he should for this reason endeavour to select that profession or business in which he takes the greatest delight.

Age and Inactivity.

We have seen that the internal work of the body persists throughout life. In like manner, the external work should be continued in some measure as long as life and strength permit. Manifestly a man's usual occupation is that best fitted to exercise all his faculties with the least expenditure of energy and the greatest amount of pleasure. Excepting for consideration of health, it should not therefore be lightly dropped. The idea of making a fortune or a competency and thereafter retiring from active labour is almost always in the forefront of a young man's mind, but if he is a wise man he will refrain from the realisation of a desire formed during the period of mental immaturity. To retire from active participation in the work of life so long as any working capacity exists is usually a great blunder. It is pathetic to see the aimless wandering about and the mental vacuity which overtake the man who has retired in middle life without some adequate substitute for his usual occupation. Nature not infrequently revenges herself on such a departure from her laws by a premature decay of all the faculties and the supervention of some disease which often terminates fatally. The men who "die in harness" are those who have most completely mastered the Art of Life.

It is the law of life that, if a man will not work, he should not eat. We have, indeed, seen that the less one works the less desire one has to eat, a perfectly natural

sequence. Labour always brings its own reward, for the habit of industry ennobles the character, endows one with independence of mind, is a solace in time of grief, and if it does not ensure happiness is one of the indispensable requisites for that state. Carlyle says, "Work is the grand cure of all maladies and miseries that beset mankind—honest work which you intend getting done." Who can forget the climax of his "Everlasting Yea"? "Produce! Produce! Were it but the pitifullest infinitesimal fraction of a product, produce it, in God's name. Work while it is called to-day, for the night cometh wherein no man can work."

Practical Summary.

1. Regular work is the best guarantee against disease. Work is not a necessary evil, but necessary both for physical and mental salvation.

2. As long as life lasts every cell of the body is at work to ensure its own life and produce a surplus for the community of cells which constitute the body. This process is called metabolism.

3. The work of the body itself is therefore of two kinds—internal, *i.e.* that work whereby it is enabled to exist; and external, *i.e.* that work whereby it justifies its existence.

4. Compared with the best steam engine, the human body shows to much greater advantage.

5. Food and oxygen constitute the fuel of the human engine. Foods are artificially divided into "body-building" and "energy-producing."

6. The body cannot exist on pure proteins. Even carnivorous animals cannot live on pure protein, and indeed develop greater energy on a fleshless diet.

7. The body cannot live on fat alone, nor on carbohydrate alone, nor even on the two combined.

8. It can, however, live on fat and protein, or carbohydrate and protein.

9. Fat is stored in the body as a reserve of energy-producing material. It is not so necessary to-day as in days when food was more difficult to obtain, and clothing was less universal.

10. Obesity is produced by the deposit of an excess of fat, and, shortly speaking, can only occur in two ways —by eating too much or exercising too little.

11. To reduce obesity, therefore, the total daily quantity of food ought to be diminished, more exercise taken, and fluids ignored at meal-time.

12. To put on fat, more food, especially carbohydrate and fat, should be taken, as little exercise as possible, and fluids should be taken with meals.

13. The first condition of good health is a life made fruitful by toil and ennobled by good actions.

14. Laziness is at the root of most failures, and degradation follows idleness.

CHAPTER V.

REST.

LAW IV.—"Sleep should never be restricted to a definite number of hours, but for the average man eight hours or more should be the rule."

THERE is no such thing during life as absolute rest in the working activities of the body, but during our waking hours most of the organs have periods of modified rest, and this rhythmic action may be said to be the rule of life. Even such apparently ceaseless movements as those of the heart and of respiration are not conducted without definite though brief pauses of recuperation.

During the hours of consciousness the nervous system, which is the controlling mechanism of all bodily functioning, can obviously obtain no rest, since it is continually giving forth energy to every part of the economy. A special time, therefore, has to be found during which it can attend to its own recuperation and, as it were, look after its own affairs. This it does during the period of sleep, when all the vital parts of the nervous system are enabled to rehabilitate themselves.

The Two Nervous Systems.

That we may intelligently appreciate the nature and office of sleep, let us glance briefly at the structure and functions of the nervous system. It is divided into two

distinct branches, one well known—the cerebro-spinal nervous system, and the other less well known—the sympathetic nervous system.

1. The cerebro-spinal nervous system consists of the brain, the spinal cord, and the nerves.

(*a*) The brain is snugly ensconced within the skull and three strong investing membranes, and rests on a springy bed of cerebro-spinal fluid. It weighs about three pounds in man, and a few ounces less in woman. The cerebrum or brain proper is divided into two hemispheres by a deep groove, and intersected by many smaller furrows which throw its surface into what are called the convolutions. The hemispheres are composed externally of a husk of grey matter, and internally of a kernel of white matter. Behind the cerebrum lies the cerebellum or lesser brain, and between these two and the spinal cord is the medulla oblongata.

(*b*) The spinal cord is contained in the spinal canal formed by the vertebral column, is about eighteen inches long, and, like the medulla oblongata, is composed of white substance externally and grey substance internally.

(*c*) The nerves spring in twelve pairs from the brain and thirty-one pairs from the spinal cord.

In intimate structure the brain consists of cells and fibres, with blood vessels for their nutrition and lymphatic vessels for their drainage, and a binding or cementing substance, called the neuroglia, to keep them altogether.

The cells, which are much the most important constituents, and of which the "grey matter" is chiefly composed, are small masses of finely granular substance called protoplasm, with a central part (the nucleus), and varied in their shape, stretching in every case into various processes or dendrites. Each cell, if not sur-

rounded by a capillary blood vessel, has immediate access to one, and can extract from it, during rest and sleep, the active principle of its vitality, called "chromatic granules." After a hard day's thinking or physical exertion, or during disease and exhaustion, this, which is the material for potential work, is seen to be exhausted and to exist in very small quantity, but it is restored during sleep by the ordinary processes of nutrition. The spreading branches of the cells or "dendrites" are connected, some with neighbouring dendrites and cells, and always with one large one which goes to the spinal cord, and through this communicates with the nerves and so with every cell in the body.

The "Grey Matter" of the Brain.

From this brief description of the structure of the brain it is possible to see an analogy between it and a large electric battery. Each cell of the battery is fitted with chemicals containing a definite quantity of potential energy, and by their action on each other gradually emitting a corresponding quantity of actual or kinetic energy capable of passing along a wire to do some work at a distance. The cells of the brain in like manner evolve nerve force, using up chromatic granules by converting their potential into actual energy, and this passes out through the spinal cord into the nerves and every cell of the body.

But here the analogy ceases, for, whereas the nerve cell can be restored to its potentiality by rest and sleep, the chemicals of the cell must be renewed by artificial means. The brain cells are joined together into many groups in a somewhat intricate fashion, and so the "association of ideas" becomes possible, and they are capable of receiving impressions from without and storing them up for an indefinite period of time. There

are said to be from six hundred to three thousand million of them, so that their capacity is infinite.

An important characteristic of the grey matter of the brain is that it has five or six times more capillary blood vessels than are allotted to the white matter, which contains no cells but only fibres. This shows that the function of the cells is vastly the more important of the two, and we are hence led to the conclusion that they are the generators of nerve force, and the fibres only the conductors of it.

The functions of the brain may be shortly classified as fourfold.

(1) *Motor.*—The process of generating and transmitting motor impulses.

(2) *Sensory.*—The power of perceiving sensations both general and special.

(3) *Nutritive.*—Regulating the blood vessels and so controlling the amount that passes to each organ of the body.

(4) *Ideo-motor.* — The power of forming ideas, exercising intelligence and volition. This is its chief function, and includes everything that constitutes mind, judgment, attention, volition, imagination, memory, and so forth.

The cerebrum is therefore the means by which an individual receives impressions from the outer world, imparts communications to certain instruments of motion, the muscles, and governs the body by a conscious, intelligent will.

The cerebellum regulates or co-ordinates muscular movements.

The medulla oblongata conducts the impressions both to and from the body generally, and at the same time contains many important nerve centres of an

independent character, ruling the heart, circulation, and respiration.

The spinal cord acts as a conducting medium, and contains many subsidiary centres for local reflex activities.

The Seat of Emotions.

The nerves are simply conducting agencies.

The sympathetic nervous system consists of knots or masses of nervous tissue called ganglia, arranged partly in two rows or chains on either side of the vertebral column, and partly in other regions of the body. The latter include large and well-defined ganglia such as the cardiac and other organic plexuses and the greater solar or epigastric plexus, the so-called "abdominal brain." From these emanate nerves called the vaso-motor nerves, which supply all the blood vessels of the body and enable them to be dilated or contracted according to the necessities or vicissitudes of the tissues —hence called vaso-dilator and vaso-constrictor.

The sympathetic nervous system acts to a large extent independently of the brain and spinal cord, although in intimate association with them, and is the medium whereby our emotions express themselves; for these have their seat not in our heads but in our bodies, as the language of all nations bears testimony. It presides over and influences all those processes in the body which, fortunately for our comfort and convenience, are carried on, waking and sleeping, independently of our will, and is therefore the great nutritive agency of the body. It is distributed to all unstriped muscular fibre of the body, whether in the heart, blood vessels or viscera, such as the stomach, bowels, etc.

Its messages are almost entirely of an unconscious character, and the best indication of a healthy body is that its functions should be carried on automatically

and without the knowledge of the individual. For a man to be conscions of the working of his heart, or stomach, or lungs, is unhealthy, and augurs ill for his happiness. In these days of civilisation or cityfication such cases are unhappily too common, and are traceable to the cultivation or gratification of the feelings instead of or at the expense of the intellect.

What Happens in Sleep.

During sleep the nervous system is in a quiescent condition, its function being curtailed, and those which persist being carried on in a modified manner. When we are awake our intellects, emotions, and volition are in a state of activity, and molecular changes occur in the brain of a kind already somewhat indicated. During sleep, however, this molecular activity ceases, the mental operations are superseded, and consciousness and volition are in abeyance.

All parts of the brain are not always active during our waking hours, as one part may only be functioning at a time, whilst others are in repose; but during sound sleep all are at rest. The motor and sensory centres are likewise tranquil, whilst their nerves transmit impressions imperfectly. The centres for breathing and circulation in the medulla are, as far as is practicable, asleep, and the spinal cord is also much less active and its reflexes can only be aroused by very strong stimuli. The condition of the sympathetic apparatus is unknown, but the emotions at least are inactive. Thus during sleep all parts of the nervous system are in a state of repose, and the bodily activities are carried on with the smallest expenditure of energy.

During the exercise of its functions, besides the dissipation of the chromatic granules, other profound changes take place in the nervous system, the precise nature of which has not been clearly determined. It is

known, however, that nerve substance, which, when at rest, is neutral or feebly alkaline, becomes acid as the result of activity, and one is quite justified in concluding that similar changes take place to those occurring in the muscles, the nett result being a diminution in the size of the nerve cell and an accumulation of acid waste products. During sleep, therefore, in addition to the cessation of the functioning of the nervous system, these products of its metabolism are excreted, and its potential energy is restored.

The Collapse of Consciousness.

Sleep does not occur instantaneously, but the various parts of the nervous system gradually take upon themselves the condition of repose. Excitability of any of these is apt to disturb the repose of the whole body, and therefore it is of great importance to make a proper use of each part of the body daily, so that insomnia may not arise.

The first parts to come under the influence of the somnolent condition are the centres presiding over the muscular system, and so we find one group of muscles after another gradually relaxing until the horizontal position is attained. The motor centres in the spinal cord succumb at a later period, and, as they are active when those in the brain are inactive, and hence cannot exercise their inhibitory influence over them, various spasmodic muscular jerks are apt to take place, which most of us have experienced at one time or another. Probably this is also the explanation of the frequent occurrence of epileptic attacks and other convulsive seizures during sleep.

Thereafter, the various mental faculties succumb in a regular order—first the power of attention and judgment, and then the memory, and so for a short time the imagination is inclined to wander away in revelries of

its own, till all intellectual functioning ceases, or, at any rate, the conceptions of time and space cease to control thought. Then the centres for the special senses become inactive in turn, beginning with vision. The eyelids close, the eyeballs turn upwards and inwards, as if to shut out all light, and the pupils contract in proportion to the depth of slumber.

The power of hearing comes next in order of disappearance, and it need hardly be observed that noises are amongst the most frequent causes of insomnia, compelling the auditory centres to remain active. It is strange how a loud, unaccustomed noise may fail to waken a sleeper, when an expected one will rouse him at once even before the usual time. Witness the rapidity with which a sleeping dog responds to his name casually mentioned in the course of a hitherto neglected conversation. Monotonous sounds are most easily forgotten unless when they suddenly cease, as during a railway journey. But many monotonous sounds are useful to woo sleep by a hypnotic process.

The centres in the medulla never become quite oblivious, but slow down, and so the heart-beat and respiration continue at a lesser rate. It will thus be noted that the order in which these mental faculties are eclipsed by sleep is the reverse order to that of their development in the evolutionary process; they follow the "Law of Dissolution" exemplified by the action of alcohol and most other poisons on the brain. It would almost seem as if the toxins of fatigue have much to do with the causation of sleep, as indeed has been frequently suggested, but an alternative explanation is that the blood supply of the centres becomes lessened in proportion to their distance from the heart.

It is important to note that during sleep, at any rate

in the recumbent position, the heart beats from ten to twenty times less frequently each minute, or quite five thousand times less during a night, whilst the respiratory function drops from sixteen or thereby to twelve per minute, and is much more shallow than during the waking hours.

The temperature of the body falls from a half to two degrees Fahrenheit, and three times less heat is lost than when in the waking state. The secretions of the mouth and most mucous membranes are greatly lessened, and the movements of the stomach and bowel almost disappear. The secretion of urine is only about a quarter of the quantity passed during the day, and it is notable that much more phosphoric acid is excreted during the night period—an indication that the waste products are being expelled and nutrition taking place in the nervous system. The urines of sleep are said to contain convulsants, those of the waking state narcotics.

First Sleep the Soundest.

The depth of the sleep varies according to the circumstances in the same individual, and vastly in different individuals, but it is the rule in healthy people that the intensity is greatest during the first hour, and gradually diminishes. Doubtless this is the explanation of the well-known fact that "forty winks" or so after dinner and after a period of stress produces quite a notable recuperation of the powers, and it is probably also the reason why some people can do with much less sleep than others.

We have seen elsewhere that the temperature, and hence the vitality, is at its lowest ebb about 2 a.m., and for this reason two hours' sleep before 12 o'clock are distinctly worth four thereafter, as it is the best preparation for such an hour to have had as long as possible in which to recuperate the vital functions.

Much argument has raged and still rages round the scientific explanation of sleep. It has been attributed to many causes, but the theory most in favour is that it is due to anæmia or pallor of the surface of the brain. That this is the physiological condition present in the vast majority of cases is an assured fact, and equally so that it is accompanied by a flushing of the skin, which makes room for the displaced blood. Experimental evidence exists in plenty to prove that at the moment of sleep the skin flushes and the brain becomes pale, the conditions being reversed at the moment of waking.

For long it was doubted whether it was possible to increase or diminish the quantity of blood in the brain, but this has now been established beyond the possibility of doubt. It is very important to remember this fact, because the blood supply of the brain is arranged on a peculiar principle, whereby, according to the necessities of the various areas called into activity by the association of ideas, the tap may be turned on with the necessary supply for any isolated point or for many at the same time, much in the same way as it is possible to turn on electric lights in any part of a large hall. When any part of the brain is functionally active, an increased supply of blood, varying from 30 per cent. to 50 per cent. above the normal, is hurried to that part, and when it again becomes quiescent the blood supply decreases. If, therefore, any of the organs of the body be compelled to exercise their functions during sleep, as, *e.g.*, when a hearty meal has been partaken of shortly before retiring, the part of the brain which is responsible for the control of that organ becomes unduly flushed with blood and interferes with the soundness of the sleep. Nor are the organ and its cerebral connections able to obtain their own rest and so rid themselves of

their waste matters and renew their nerve substance, so that chronic irregularities of this kind lead to a far-reaching disturbance of the body's economy.

Theories of Slumber.

On account of the fact that sleep is not incompatible with extreme congestion of the brain, other explanations have been offered, such as the suggestion that it is due to the lack of oxygen in the air of the apartment, and it is known that everything that robs the air of oxygen is conducive to sleep. It could not well be otherwise, as the oxygen in the red blood corpuscles is the active agent in the combustion of the tissues, and the anæmia of the brain is only another way of cutting off the supply by limiting the quantity of blood.

A familiar example of sleep induced by lack of oxygen is the drowsiness which gradually steals over one in a crowded place of worship, although hypnotism from the steady glare at the preacher for a lengthened period and the monotonous sound of his voice have also been considered in some degree accountable.

It has also been suggested that the increase of the acid waste products of fatigue, which are, of course, toxic and allied to lactic acid, has something to do with the production of sleep, but the injection of lactic acid has failed to bring on sleep. It is, however, no sufficient objection to this theory that one may fall asleep in a railway train on a hot day, even although not fatigued, because bad ventilation is quite capable of accounting for this. Idiots and others whose brains are inactive usually sleep much better and longer than those who work their brains at high pressure and presumably manufacture a much greater quantity of fatigue products. Still, the toxic waste matters in a measure paralyse the brain cells and are no doubt a contributory factor in the causation of sleep.

Which of these theories is the correct explanation of the cause of sleep is not of vital importance, and it is more than likely that each of them has some part to play in the process. It was needful to mention them, however, because a correct appreciation of them will enable us to understand why it is that so many methods have been suggested for wooing unwilling sleep, and that so many of these are quite valueless.

The Sleep required.

Men, as a rule, require less sleep than women, who possess much more highly susceptible and sensitive nervous systems, and whose hearts beat on an average five times per minute more than a man's. Women, however, bear the want of sleep temporarily better than men, and are capable of undergoing long spells of fatigue in highly monotonous and uncongenial work in close rooms. An infant should sleep practically all the time not required for feeding, and this time may be gradually diminished until at about ten years of age about half the day is devoted to rest. Between ten and twenty, from nine to ten hours should suffice. From twenty to sixty or thereabouts there should be eight hours, and after this age as much sleep should be taken as can be obtained. Sleep is not so necessary in advanced years as in young people, because the old need only to repair the daily waste of tissue, whereas the young require in addition much energy for growth and development. Nevertheless, good sleepers amongst the aged are those who live longest.

Enough has been said to show that there is no absolute rule for the duration of sleep, but that in all cases a sufficient amount should be taken to recruit all the energies, so that on waking in the morning a stretch and a yawn are all that are necessary to start the vital processes into a daytime of bounding vigour. But the

length of the sleeping time is not the only criterion of its value, because individuals differ in the quality of sleep which they obtain. It is quite a common experience to find that a short sleep is of greater value than a prolonged one, and, *mirabile dictu*, that all the feeling of restfulness acquired by a few hours' rest is dissipated by a second sleep in the late hours of the morning. Probably temperament has much to do with these differences, as we know that people of a sanguine temperament bear the loss of sleep badly, whereas those of a neurotic temperament may be said never to sleep well and yet be capable of enduring a great amount of exhausting labour.

Sleeping at Will.

We occasionally meet those who have the power of commanding sleep at will—a most valuable faculty which may be cultivated by practice. The names of Napoleon, John Wesley, and the great Duke of Wellington will immediately suggest themselves in this connection. This is the class of men who sing the praises of early rising, a habit which suits their constitutions admirably, but has gone far to wreck that of many a growing youth who attempted to emulate their example. Especially is this the case when the early rising has been utilised for some form of vigorous exercise or physical culture under the plea of developing the body. The genus physical-culturist has much to answer for by inculcating such an idea amongst its followers, and many of the breakdowns so frequently witnessed amongst those under the spell of the physical culture craze are due to this waste of renewed tissue at a time when the repair of tissue had not been completed.

Those engaged in literary or other sedentary occupations of an intellectual type require less sleep than those engaged in work demanding the use of the muscles.

Probably this is because they have acquired the habit of sleeping methodically, just as they do everything else, in contrast to the lack of method displayed by the average manual labourer. They are, however, more apt to develop insomnia by reason of the fact that their brain cells, having acquired a larger supply of blood during their activity, find it difficult to attain to that condition of anæmia conducive to sleep. Manual labourers, on the other hand, find that their occupation tends to draft the blood to their muscles and away from their brains, and they accumulate a sufficient amount of waste products in their tissues to foster and encourage sleep.

Whilst, however, a certain amount of muscular exertion is necessary for sound sleep, it is quite otherwise where fatigue either of body or mind exists, and we strike here a fallacy of the " Nature cure " theorists who prescribe hard physical culture just before bedtime to the man already exhausted by his day's labour.

Large eaters sleep more than small eaters, because the blood is drained from their cranial cavities to their digestive organs.

Sleep is not so sound nor so prolonged during summer as during winter, because in cold weather much more energy is expended in keeping the body warm, and so a greater amount of tissue is wasted. For the same reason, sleep is sounder and more refreshing in cold and bracing climates than in warm and relaxing climates. Hence the value of a bracing hilly district, as compared with the relaxing sea-side resort—although excessively high stations are not satisfactory sleep-producers.

Bad sleepers may be divided into two categories: (1) Those who fall asleep at once, but wake after a few hours. These either have highly sensitive brains or

are full of toxins of indigestion, rheumatism, or gout. (2) Those who cannot go to sleep on retiring, but toss about for hours. In these we must look for excess in the consumption of tea or coffee, or habits of overwork. The statement has been made on fairly efficient authority, that five absolutely sleepless nights are sufficient to cause death, and that two completely wakeful nights have been followed by loss of memory, hallucinations, and unmistakable evidence of mental disorganisation with great physical depression.

The War with Insomnia.

Where any tendency to insomnia exists, one may be sure that some law of health has been or is being broken, and steps should be taken at once to discover the default and remove it. That this is not an easy matter is well illustrated by the evasive yet facetious reply of the medical man who, advising his patient to eat something just before going to bed, was met with the reply, "Why, doctor, you once told me never to eat anything before going to bed." The doctor with dignity replied, "Pooh! pooh! that was last January. Science has made enormous strides since then." The ceaseless progress of physiological research, no less than the extreme variety of conditions exemplified in the members of the race, must always restrain the over-confident diagnosis of individual cases.

The place of repose should be constructed in accordance with well-known sanitary laws, and the ventilation should be especially carefully attended to. For this purpose the open bedroom window night and day is an absolute necessity, despite which fact many strong people have been nurtured in an atmosphere chiefly characterised by its lack of oxygen. Indeed, many people find out for themselves that the only way to encourage sleep is to bury their heads under the bed-

clothes, where, fortunately for them, they are unable to remain for any length of time.

Quite recently in one of the medical papers the suggestion was made that sleep should be induced by taking a long inspiration, retaining it as long as possible, and then repeating the process. The same condition can be brought about by taking shallow infrequent breaths until somnolence appears. In spite, however, of the fact that badly aerated blood tends to encourage sleep, it is unwise to have the bedchamber full of foul air. It is true that the carbonic acid may do less harm than is supposed, and that the diminution of oxygen tends to have a hypnotic effect; yet the organic impurities with which the air is heavily loaded are the favourite haunting places of the tubercle bacillus, which thereby may get its chance of working deadly harm.

Blue blinds to exclude the light are often necessary, and any form of light is harmful. Curtains either at the window or round the bed are a relic of the dark ages, and drapings to hide dusty accumulations of years are criminal.

The Ideal Bedroom.

The ideal bedroom should face the south and open on to a wide covered verandah. It should be of ample dimensions, if possible eighteen feet long by sixteen feet wide. The floor should be varnished or parquetted, with an occasional mat, and the walls covered with a convenient shade of sanitary distemper. No angles or corners should exist in the room, not even where floor and ceiling meet the walls. The side abutting on the verandah should be framed in glass and removable. In favoured days in the winter this glass screen may be removed, when practically an open-air chamber would exist, and in the summer the bed should be removed to

the verandah. Certainly a "counsel of perfection" difficult to achieve, and made more difficult by the suggestion that a dressing-room and a bathroom should be attached to each ideal bedroom.

The bed should be of polished wood or metal, should not be situated in an angle of the room, should be at least half a foot from the wall, and should be so placed that the sleeper is not subjected to draughts. There is no special reason for putting its head north, south, east, or west, unless to suit the fancy of the sleeper.

Every person should occupy a separate bed, and this maxim applies to the married in particular. The bed furnishing should consist of a hair mattress on a wire, or better a sofa spring mattress covered by a blanket and an absorbent sheet. Softer mattresses are still favoured by a few, but they are unhealthy and have been proved to be dangerous, many containing more microbes than sewage, as has been proved recently by the Chief Sanitary Inspector of Glasgow. The bed-clothes should be warm but light, and the temperature of the room about 58° F.

A higher temperature in the room causes increased action of the heart, and is inimical to sound sleep, whereas too low a temperature depresses the blood vessels of the skin and so congests the heart. If the feet be cold, then a hot water bottle is not a pandering to the weakness of the flesh but an actual necessity, and warm bed socks should always be worn in winter. When noises cannot be excluded, the ears should be stopped with cotton wool. Plants should never be kept in a bedroom.

The best attitude is that which is most comfortable, but if it can be varied, that is advisable. Many lie first on their left side, then on the right, and finally on

their back, but it is probably best to sleep on the right side. The heart lies more to the left, and is apt to inconvenience the sleeper. When lying on the back, the stomach and colon are likely, with their weighty contents, to press on the great nerve centres, and so excite nightmares. In the morning it is wise to rest on the left side, so as to encourage the matutinal "move on" of the fæces towards the sigmoid flexure and rectum.

The last meal should not be a heavy one, but if it is, it should be eaten not less than four hours before bedtime. Frequently a glass of hot water at bedtime is useful, although there are those who find an apple an admirable soporific.

Cures for Sleeplessness.

Where, despite attention to all these details, sleep refuses to visit the heavy eyelids, a hop pillow is often found to be a valuable expedient. By those who are accustomed to much brain work a fairly high pillow will be found most suitable, whereas the manual labourer will find he can sleep quite well with a low pillow. And indeed this is less liable to produce a "crick in the neck."

A smart long walk just before bedtime is an excellent hypnotic for some, especially if, the moment home is reached, the clothing be removed and bed resorted to. A hot foot bath may be more satisfactory, although, if it be too hot and unduly prolonged, wakefulness may be the result. Massage may favour or retard the tendency to sleep, but an abdominal compress is nearly always useful. For this a piece of swansdown or calico three yards long and eighteen inches wide should be wrung out of tepid water for a third of its length and applied to the abdomen, whilst the other two-thirds are wrapped round and pinned firmly over it.

All sorts of devices are recommended for wearying the

brain, such as counting endless numbers, repeating the same word continuously, repeating verses, or reading an uninteresting author just before closing the eyes. It is always wise to read a light novel or engage in some social dissipation for the last half-hour at least before retiring. Many find that one of the thin-paper editions of the standard authors or a sixpenny edition of a novel need only be read for three or four minutes to bring on the wished-for slumber. Perfect quietude is not indispensable, because the loud ticking of a clock or other monotonous noise or vibration is sometimes of great value. Some have even recommended deep breathing, but this is hopelessly at variance with the physiological accompaniments of the onset of sleep.

A good deal of the layman's advice proffered for the treatment of insomnia is much on a par with that of the Irishman who, on hearing of his friend's affliction, declared that he knew the only cure for insomnia, and that was just to go to sleep and forget all about it.

A Sound Plan.

It will be seen that most of the suggestions—at least the useful ones—are simply efforts to bring about one or other of the physical conditions that are known to precede sleep, and it seems reasonable that a process which would imitate nature in all her details would be likely to be followed by success.

The following method, which I have personally practised for many years, has been attended by the most favourable results, both in my own case and that of others to whom I have recommended it. Invalids generally, and those who are afflicted with insomnia, are often exasperated by the thoughtless advice that they should "try to go to sleep," and are ever ready with the rejoinder that the more they try the less do they attain the end. Nothing could be more in accordance with the

truth, because the misfortune is that, in common with all well meant but useless advice—which is usually given for the perfunctory purposes of conversation—no instructions are given as to how the effort should be made. Hence a real muscular struggle usually ensues, accompanied by a clenching of the hands and jaws, a tensing of the throat muscles, a strong compression of the eyelids, a screwing up of the face, a shrugging of the shoulders, a drawing up of the knees, and an attempt to hold on to the bed instead of giving up the whole weight to it and placidly disposing of one's self to oblivion.

The fact is either unknown or forgotten that the preliminary stage of somnolence is a complete relaxation of all the muscles, and this is essential before sleep can possibly take place. Instead of the motor centres getting a chance to rest, they are being asked to work at a higher pitch in an endeavour to do something which is not clearly understood. At the same time, an effort is being made to stop thinking, which seems to be the great bugbear of the sufferer from insomnia. This presupposes that the attention is being directed to regulate the process in the forlorn hope of bringing about a cessation of the process of thought. But attention is the very thing which stimulates thought, causing one idea to chase another all round the brain, as it were, following out the law of the association of ideas.

Now, if a plan could be devised of getting the motor centres and the attention to go to sleep, the other stages would follow as a matter of course. This is what happens in the method I am about to suggest. First lie in the most comfortable position possible, and this is usually on the right side with the knees slightly flexed. Then, with the lips closed but not compressed, drop the

lower jaw and relax the tongue, gently shut the eyes and draw the bedclothes over the exposed left ear. This shuts out light and sound and relaxes some muscles which are usually forgotten. Now proceed to relax more muscles, beginning at the feet, legs, thighs, and arms, imagining each in turn a heavy weight bearing down upon the bed ; and lastly, imagine that the eyes are looking far away to the distant horizon. The attention is so taken up with the relaxing process, that thinking soon ceases, and the imagination, instead of running riot at its sweet will, is set to play on something definitely soothing and soon falls asleep. This desirable result is more readily brought about by a slowing and shallowing of the process of breathing.

Subsidiary Methods.

Expertness in the method will easily be acquired by a little practice, and many hundreds of doses of dangerous hypnotics could be avoided if this simple imitation of the physiological stages of natural sleep were put into operation. It is rarely necessary to do anything more to induce sleep, but sometimes it is wise as a preliminary, in order to distract the attention from business or other worries, to read a few pages of some light novel. In any case it is never judicious to lie abed tossing about, as this will only increase the misery and diminish the chances of sleep. It is much better to get up, take a little walk round the room, eat an apple or other form of fruit, or drink a glass of hot water.

The most seductive form of hypnotic is alcohol in the form of whisky, because it tends to produce an initial sleep of short duration. But in addition to the risk of falling a victim to its craving, it loses its effect about three or four hours after it has been swallowed, and a more severe form of insomnia is thus induced.

It is sometimes advisable, in cases of disease, to use a

soporific drug, but this should never be done without the advice of the doctor, on account of the danger of instituting a habit. Besides, drugs for this purpose always make a difference in the morning, and often fill the mind with morbid fancies and dangerous obsessions. In the vast majority of cases the cause of insomnia is physical and due to an uncontrolled consciousness, and the true treatment is to inhibit this consciousness by a natural process—not to numb it by narcotic agencies.

Rest and Fatigue.

Having dealt with sleep at some length, we may next turn our attention to the question of rest and fatigue. It may be briefly stated that a short rest of at least twenty minutes' duration should follow each meal, and after any strenuous effort ten minutes at full length on a couch will be found an efficient reviver.

The problem of fatigue is by no means a simple one, but much has been done in the elucidation of its causation by Mosso, Professor of Physiology at Turin. Amongst the many interesting facts brought to light by him and others, the following are of striking interest. It is well known that if a frog's muscle which has been completely exhausted by the stimulation of an electric current until it refuses any longer to respond, be washed out by injecting into its substance ordinary salt solution, the electric current can again cause it to contract almost as well as before. If again, some of the blood from an exhausted animal be injected into one which is quite free from tiredness, the latter will almost immediately exhibit all the well-known symptoms of extreme exhaustion. Evidently some chemical substances have been formed by the functional activity of the muscles, which are inimical to their further action.

Careful experiment has demonstrated that the follow-

ing chemical changes take place in a muscle which has been exercised :—(1) Its chemical reaction changes from alkaline to acid; (2) it consumes much more oxygen and eliminates much more carbonic acid; (3) it contains more water; (4) it yields a larger quantity of extractives soluble in alcohol, and a smaller quantity soluble in water; (5) it yields a lessened quantity of substances capable of producing carbonic acid and less glycogen; (6) it yields less fatty acids—creatin and creatinin.

Similar changes take place in actively functioning tissues all over the body, all of which, like muscles, lose some of their substance by working, and require rest in order to its renovation or restitution. This tissue waste is of course expelled into the blood, and is acid in character, and it really exercises an important and beneficial function in the economy by restraining further fatigue of an excessive character. It acts, in fact, as a sedative upon the nerve centres, and is one of the direct cases of rest and sleep.

When the functions of the body organs, however, are unduly exercised, an abnormal quantity of waste products is excreted into the blood, where they act as toxins to all the body tissues. Instead of sedatives, they now act as excitants or irritants, and this explains the nervousness and irritable weakness of exhausted states and the insomnia of overfatigue. In addition to this the waste substances have a tendency to irritate the kidneys and produce organic changes, and, being insufficiently excreted, are deposited in the tissues, causing the aches and pains so well known in fatigue. Now, no two men are constituted alike, and they vary not only in their food and habits but in their ability to withstand the effects of exhaustion. An amount of exercise which in one would be followed by a pleasurable sense of

tiredness, would in another be followed by intense fatigue.

In this connection another interesting fact is of great importance. If a finger be attached to an ergograph (*e.g.* an instrument for recording the number of times the muscles contract), and made to move until from fatigue it is quite incapable of performing another movement, then the galvanic current applied to the finger will still cause it to contract actively, and so will a faradic current applied to the nerve.

Fatigue an Affair of the Brain.

This shows that the fatigue is not due either to the muscles or to the nerves controlling them, but to the brain cells which preside over them. In other words, fatigue is largely dependent upon the mind, and this fact is clearly recognised in the army, where music is employed for the distinct purpose of stimulating the flagging steps of the exhausted soldiers. Now, where a sufficiency of rest is indulged in, the waste products of fatigue are removed with comparative ease and the tissues restored to their normal state, but where an undue expenditure of energy occurs a condition is established in which neither physiological rest nor food will restore the body to the equilibrium observed in health, and a condition known as nervous debility or neurasthenia arises. It is truly a condition of chronic fatigue, and all its well-known symptoms are to be attributed to this cause.

Nervous Temperament.

Although neurasthenia no doubt arises in a large measure from neglect to rest when the necessity arises, and although any one who pursues these indiscretions may become a victim, those of a nervous temperament are much more prone to the disorder than others.

It is easy to pick out the typically nervous man by his spare habit of body, large prominent veins, quick

alert movements, often abrupt and hasty, even jerky, although at times he may appear too languid. His leading characteristic is a want of balance or control and his great danger is loss of self-control. He feels pain acutely, although he can endure great fatigue and even privation for a short time and is always at work on some problem or another. It has been well said that he always appears to be able to do more than he is doing or to be doing more than he is able. He lacks repose and restfulness and the secret of his tendency to nervous breakdown is his constant, more or less, useless expenditure of energy.

The nervous system has been compared to an accumulator or storage battery which is charged during sleep. Now that motor cars are so common, most people are familiar with accumulators, which contain a certain store of electricity for the purpose of creating a spark to fire the mixture of petrol and air in the cylinders. When this falls below a certain amount it is unable to exercise its function, and requires to be returned to a charging station for a fresh supply of electricity. According to their constitution, some accumulators can retain their store much longer than others of the same capacity, throwing it off less violently, but in a perfectly effective quantity for the required purpose. It is not always clear why this difference should exist, but it is certain that it does exist, as any motorist knows. Most of the accumulators are sent out with about four and three-quarter volts, and when the odd three-quarters of a volt have been expended and the volt-meter only registers four volts it is time to send it to be recharged, and on an average this occurs once a month.

The nervous system of the average man should never

run down so much in one day that it cannot be restored or recharged, as it were, by the rest and sleep of the same twenty-four hours. There should always be a sufficient reserve of energy to meet any ordinary or even extraordinary call upon it. The fatigue products which accumulate throughout the day should be excreted with ease during the short periods of rest allowed in the day-time and the eight hours or so allotted to sleep during the night-time, and at the same time the tissues should be restored with potential energy. This should be sufficient in amount to answer all the calls upon it during the waking hours, and in most cases this is what happens; but where for any reason a smaller store has been laid in, or an excessive supply is allowed to escape, exhaustion comes on, and rest and food are imperatively demanded. The individual must always keep his expenditure well within his income.

The Waste of Energy.

Now there are multitudinous ways of discharging the energy, and, whatever be the method of discharge, the result is the same in that it reduces the store. Those with a nervous temperament are prone to discharge their stores with great rapidity when working, and even throw it away uselessly when not working. I have often wondered at the cause of this waste, and speculated whether, on the analogy of the battery wires, the nerves of neurotics may not have been thicker in proportion to their size than those of quiet and reposeful people, thus providing a wider avenue for escape. In any case, physical, intellectual, spiritual, and emotional expenditure of energy all bring about the same result in the long run, namely, a depletion of the stores.

It is nonsense to say, as the fanatical physical culturist does, that a change of occupation is beneficial to a fatigued man. It may be a relief to the monotony of

work in an untired man, but any form of work exhausts the available stores of potential energy and tends towards fatigue, and if the major portion of the store be expended in physical energy, then all the less remains to be expended in other ways. It is quite easy to understand why so many disciples of physical culture are apt to break down. They have been advised by blind leaders of the blind to take exercise for the relief of their tired feeling, when rest should have been counselled—running counter to the law of exhaustion as expounded by Mosso, that "work done by a muscle already fatigued acts on that muscle in a more harmful manner than a heavier task performed under normal conditions." And on the same principle, any antitoxin for fatigue is likely to prove disappointing if not dangerous, because even although it permitted more work to be done it would only be at the expense of the vital tissues.

But not only is it wise to indulge in stated periods of rest, it is quite as essential to cultivate the spirit of repose, and this applies especially to those of a nervous temperament. Whether from an hereditarily unstable nervous system, or a wrong method of education or an unsuitable occupation, they are characterised from their cradle to the grave by the performance of purposeless actions.

One of the most common forms of wasted energy is an excessive expenditure in needlessly loud talking, even when they practise economy in their speech, which is rare. Nothing exhausts more than constant talking, unless it be the habit of talking in moving vehicles, such as railway trains, motor cars, and trams. But this is only one method, for as children we find such subjects blinking, twitching their eyelids, making hideous grimaces, going about with open mouths, constantly stretching their necks, biting

their nails or changing posture by shuffling with their feet. As they grow older they are found twiddling their fingers, and holding themselves tensely on a chair or other seat, instead of yielding to it entirely. They shrug their eyebrows and clench their jaws when thinking, and employ half the muscles of their body in every single action, instead of using only one or two specific muscles. This is ignoring such unconscious escape of energy as takes place from an uncorrected error or refraction in their eyes, or the necessary subjection of their organs of hearing to loud noises of city traffic, both of which we will consider later on.

The Features of Neurasthenia.

Let us take another and more easily understood example of a store of energy, and liken it to a reservoir of water which should deliver its supply through a regulation pipe when called upon by the opening of a tap. When one or more leakages exist in the water tank, causing a con- tant escape, the rapid depletion of the reserve stores can hen be appreciated. It is quite possible that in this llegitimate manner all the supply may become exhausted, that none is forthcoming by the usual method of with- rawal. Probably this is why the man of nervous emperament is so prone to become the victim of nervous xhaustion.

It is to be noted that in a storage battery quite a large ıpply of energy remains unexpended, even although it quite inadequate for its intended purpose, and that ıere is a comparatively small working margin. Doubt- ss this gives the clue to many cases of neurasthenia, hich have been brought about by one single great ıysical or mental strain. Instead of stopping when eir working margin was used up, the victims compelled emselves to work, and so exhausted their bodily tissues at they were never again able to be restored effectually.

In this connection it is important to remember that a very great deal of the fatigue of neurasthenia is of mental origin, and is really in the way of an auto-suggestion—a severe taking-pity on one's self—even although there is always a real nucleus of fatigue in one organ or another. Thus the real nucleus may be gastric, cardiac, cerebral, or spinal, or indeed in any organ of the body, and in the ordinary individual would be a mere passing phase, disappearing with a little mild treatment or rest. But in the victim of neurasthenia it brings about a real mental fatigue, which is of a much more serious character than the focus in the periphery.

The symptoms of neurasthenia are thus multifarious and very variable in their character, but always characterised by easy excitability to a slight stimulus, so that the term "irritable weakness" has been used to explain it. The power of volition having been weakened, the inhibitory force resident in the brain is at a discount, and the emotional or sympathetic nervous system gets its chance, causing the bodily functions to run riot, and bringing about disturbances in every part of the body. Hence pains and tender spots are always to be found present somewhere, and this leads to a habit of introspection which is much more serious than any local disorder.

The cure of the condition consists in retracing the steps along the paths of physiological rectitude, and a rigid attention to all the laws of health in the future. There is therefore no real cure in the ordinary acceptance of the term, but a bringing about of the *status quo ante* by an avoidance of the causes which led to the debacle. But although the tendency to relapse always remains, the victim may become a very much better man than he was originally, by learning to save his energy, especially

that energy which was formerly expended in the purposeless movements I have mentioned, or in the emotional outbursts so common. For this purpose a series of relaxing movements is now suggested as tending towards a proper realisation of this ideal condition, but I am inclined to think their practice is liable to bring about a greater degree of self-consciousness than is compatible with perfect self-control. In any case, they are unnecessary in the vast majority of cases if the foregoing instructions be observed.

The Formation of the Eye.

It is quite otherwise, however, with any defect in the eyes or the ears, and we must therefore consider the principle of rest as applied to these organs.

We will in Chapter VIII. briefly refer to the eye in connection with the question of cleanliness, but in order to the proper understanding of the effects of ocular strain upon the health, we must consider shortly the structure of the eye.

The eyeball consists of a large sphere, on the anterior surface of which is placed the segment of a smaller sphere, and its average diameter is about an inch. It is deeply placed in the orbit, which is surmounted by the eyebrows to give some degree of shade, and protect in some measure from dust and perspiration. The eyelids fulfil the same function, distributing tears over the surface of the eyeball from the tear gland, and by incessant winking keep the front of the eye free from dust. The eyelashes which project from the lids are likewise protective in character, and when much inflamed and distorted, not only constitute an unsightly facial blemish, but often indicate the existence of an uncorrected error of refraction. In the same way, persistent watering of the eyes is liable to arise from a similar cause.

The clear portion, like a window in front of the eye,

is called the cornea, and the white of the eye the sclerotic. The whole is lined by a very fine membrane, the conjunctiva, which is excessively fine and transparent over the cornea, but highly vascular over the sclerotic. Therefore, when much congested from irritation or injury, it quickly becomes reddened and may, as in influenza, look quite pink. It is continuous with the mucous membrane of the nose and mouth, and hence many of its inflammations, which spread from the former, cannot be cured by applications to the eye alone, but require a cleansing douche to the nose. (See Chapter VIII.)

If a pin were made to pierce the eyeball, right in the centre from the front, it would pass through in order the following structures: (1) The cornea, lined, as seen in front, with a fine continuation of the conjunctiva, and behind with an equally fine layer of endothelium. (2) The aqueous chamber, a free cavity containing a little watery alkaline fluid. (3) The pupil, the small black dot of varying size surrounded by the iris—the part which gives the colour to the eye, and is the cause of the changing dimensions of the pupil. (4) The crystalline lens—a biconvex transparent body. (5) The vitreous humour — a jelly-like substance occupying much the largest part of the body of the eyeball. (6) The retina, spread over all the vitreous humour. (7) The choroid membrane. (8) The sclerotic. The cornea and sclerotic are continuous with each other, and together form the outside coat of the eyeball. The former is transparent, for transmitting rays of light; the latter four-fifths of the whole is tough and resistant, for protecting the delicate contents.

The chief function of the iris is, by contracting and dilating, to regulate the amount of light admitted to the eye. At its outer border it is continuous with the ciliary

body and the ciliary muscle, whose function is to make the lens more convex and so enable the eye to accommodate itself to distant vision. Hence this function is called "accommodation." The choroid invests the posterior five-sixths of the globe between the retina and sclerotic, and is meant to supply blood to the interior of the eye and absorb superfluous light. The retina is the innermost of the three coats of the eyeball, and is really the surface upon which the visual image is formed and transmitted to the brain through the optic nerve.

A very common and annoying defect of the vitreous humour is the existence of microscopic opacities which are only visible to the patient in the form of "muscæ volitantes," or specks before the eye. Their existence is practically universal, and any one who cares to look up to the sky on a clear day, or on to a flat surface like a white wall, will be certain to observe them in the form of strings of beads, rings, flakes, etc., floating up and down with the movements of the eyes. They are intensified when an error of refraction exists, and are said to be more plainly visible during the condition known as "biliousness," but are apt to become less in evidence when perfectly fitting spectacles are worn, or during a holiday or other comparative form of rest for the eye.

Errors of Refraction.

The eyeball itself does not really see. It only acts like a camera and transmits an impression by means of the retina, and through the optic nerve to the brain, where the act of vision is consummated. Rays of light pass through the pupil, and the iris acts like a diaphragm, cutting off those which are too divergent to be properly refracted, while the others are focused by the crystalline lens and other refractive media on the sensitive plate of the retina. It is quite the exception for this to take place accurately, the image being sometimes found in

front of the retina, as in myopia or short-sightedness, and sometimes behind the retina, as in hyperopia or hypermetropia, or long-sightedness.

These conditions are usually fairly simple, but it is very different with the most common error of refraction, now so well known as astigmatism. It receives this name because the rays of light in the different meridia fail to be focused in the same plane, and hence an irregular image is formed. It is found in all degrees of complexity, and exists in most civilised eyes to some extent, producing little or no discomfort in early life, so long as the eyes are only used for distant vision, but capable of bringing about the most diverse consequences in the human economy when the eyes are much used for reading or close work, even to the extent of nervous debility of lifelong duration.

It is only in recent years that the malign influence which it exerts on the general health has been estimated at its true value, but so potent is its effect on the comfort of the individual that probably much of the pessimistic literature of past ages owes its origin to this defect. In any case, it is now recognised that among its victims were Carlyle with his life-long dyspepsia and lugubrious outlook on life; Huxley, with his giddiness and sickness, necessitating constant recourse to Ilkley and Switzerland; De Quincey, whose agonies were so great that 8000 drops of laudanum were ultimately required to quench them; Darwin, for whom it meant a life of ill-health and consequent ostracism from society; George Eliot, Coleridge, and doubtless hosts of others. It may seem strange that the history of these eminent literati contains little or no reference to the eyes, but this is not to be wondered at when we know that such a defect in the eye is capable of producing such manifold disorders as violent headaches,

usually of the migrainous type, obstinate dyspepsia, constipation and liver disorders, giddiness, and general nervousness, insomnia, nervous debility, chorea, epilepsy, and the severest prostration of the general health.

The method by which these varied phenomena manifest themselves in remote portions of the system is not difficult to appreciate, when we realise the close connection of the sympathetic nervous system with the eye. The ciliary and the ophthalmic ganglia are constantly irritated by the efforts of the ciliary muscle to bring about perfect vision—a result it often succeeds in effecting, but at the ever-present risk of intense loss of nervous vitality, communicated first to the ganglia in the neck, and thence to the various organs supplied by the sympathetic nervous system in the abdomen and elsewhere.

Short-sight is easily appreciated and detected by the man in the street, but long-sight and astigmatism, either singly or combined, are so frequently compensated for in the manner just mentioned that the unfortunate sufferers repudiate the slightest suggestion of ocular incapacity. It is fortunate when the effects of eye-strain are brought home by a sense of discomfort in the eyes, a blurring of the type when reading, or a difficulty in following the lines, a twitching, itching, burning, smarting, or congestion of the eyelids. But these are less frequently observed than the general or reflex symptoms already mentioned, for which in most instances many useless bottles of medicine have been swallowed before correction of the defective refraction is attempted.

The Cure of Eye-strain.

The remedial treatment of eye-strain consists in the provision of glasses, whose refracting power will suffice easily to focus the rays of light on the retina.

As a hypermetropic eye is rather shorter than the normal, and the focus of the entering rays of light is

behind the retina, a convex lens will be required to bring them forward; and, as a myopic eye is rather longer than the normal, and the rays of light are focused in front of the retina, a concave lens to diverge the rays sufficiently will be necessary.

The problem in astigmatism is much more complicated, because, although it exists from birth in some degree, it is usually much exaggerated before advice is sought, and may be daily growing worse. The continuous pressure of the tense ocular muscles, and the attendant weakening of the tissues from congestion, cause the coats of the eyeball to be pressed out of shape in various meridia. Hence cylindrical glasses must be so combined at varying angles to equalise the defects produced, and bring the rays of light to a proper focus. When the accommodation only is weak, as occurs in everybody after the age of forty-five, convex glasses are used to make up for the deficiency, and these require to be strengthened every five years or so. When there is a tendency to squint, because of weak external ocular muscles or other cause, prismatic glasses may be useful.

In every case, without exception, however, it is judicious if not absolutely essential to consult not an optician, but a medical man who has made a speciality of ophthalmic work. It is a quaint popular fallacy which ascribes to the toolmaker the necessary skill for using the tool: one might almost as well call a cutler to amputate a limb instead of calling in a surgeon, as expect an optician to correct serious or simple errors of refraction of the eyes. The optician has quite enough to do in learning how to carry out the instructions of the ophthalmic surgeon, without invading his province in the intricate processes of estimating accurately the various errors of refraction.

Spectacles are nearly always to be preferred to eye-

glasses, although the latter are certainly smarter and give a more distinguished appearance to the wearer. But they are so apt to get out of place that they may create new causes of defective vision by reason of their refracting portions being maladjusted. Spectacle lenses are made of clear flint or crown glass, and fourteen carat gold frames are cheaper in the long run, besides looking better than steel or other metal. It is a fallacy to think that the lighter spectacles are more comfortable than heavy ones, because the heavier the bridge and temple-pieces of spectacles, the more comfortable they are. Rimless glasses are sometimes to be preferred because of the lack of the confusing metal margins. Both spectacles and eyeglasses require careful adjustment on the nose, and in the case of astigmatism this is a most essential point. The lenses should be cleaned several times daily by a piece of chamois leather or unstarched cotton or linen, and once a day washed from grease and other impurities with warm water and soap.

After the age of forty-five, when artificial aid is required both for reading and distant vision, two different strengths of lens are required, but these can now be combined in the bifocal spectacles or eyeglasses, whose only objection is the necessity of becoming accustomed to going up and down stairs.

From the description of the various errors of refraction it is obvious that even properly fitting glasses may be irksome to wear at first, and this especially applies to astigmatism. They should on no account be discarded for this reason, but patiently worn until the inflammatory conditions set up by the eye-strain and the excessive activity of the ciliary muscles themselves quieten down, when the proper degree of comfort will be assured.

The Child at School.

The Prevention of Eye-strain is quite as important as its cure, as is obvious from the fact that fully 50 per cent. of school children have defective vision. In most instances this has been brought about by improper use of the eyes at home, in badly lighted rooms and in unhygienic positions of the body, and by badly constructed schoolrooms, which unhappily are not yet a thing of the past. Now that medical inspection of schools has become an established fact, it may be hoped that at least the eyesight of the next generation of young people may be conserved, and that more may be saved the nuisance of wearing spectacles.

Preventive treatment should begin from the moment of birth, and a weak boracic lotion should be employed as a cleansing agency. Infants' eyes should never be exposed to direct sunlight either inside the house or out of doors.

The crib should be so placed that the baby's face is turned from the window, and out of doors the face should be protected by a parasol or awning of a shade suitable to the eyes.

It is interesting to note that the eyes of all children are blue when born, and that they only take on their typical colour a few months after birth—a response to some inborn necessity for protection. In this case, therefore, the dictates of fashion are not alone answerable for the shade of the baby's trappings, but correspond for once to the demands of nature.

During the growth of the child it should be encouraged to use its eyes at a distance rather close at hand, and it must not be allowed to use the same towels, handkerchiefs, or drinking utensils as other children.

Seven years of age is soon enough for its eyes to be used for reading, and even if the exigencies of modern

society or modern Acts of Parliament compel it to go to school at an earlier age, no close work of any description should be undertaken. Until the age of ten a good deal more time should be spent in open-air exercise and games than in close work for the eyes, and both these and the bodily health will be thereby so immensely strengthened that any apparent loss of time will soon be made up for by increased capability for work.

School buildings should be located in healthful situations, free from polluted atmosphere and away from disturbing noises, and with sufficient surrounding space for playground. The room should be oblong, lighted by windows on the left side, or slightly at the rear as well, and, if possible, should look out on a wide unobstructed area or the open sky. There should be 1 square foot of window space to each 4 square feet of floor space, and the light should be direct and come in over a sill 4 feet in height—thus over the heads of the pupils. The windows should be shaded by holland blinds of a lightish colour, and the walls and ceilings should also be of some light-reflecting colour. The desks and seats should never face the window, and should be adjustable. The edge of the desk should project slightly over the edge of the seat; the top should incline downwards from the horizontal about ten degrees towards the pupil, and be low enough to allow the forearm to rest without raising the shoulder. The seat should be hard enough to support the whole thigh, and low enough to allow the sole of the foot to rest on the floor. The back should be curved forward to support the loins.

All reading material, whether in books, charts, maps, or on blackboards, should be sufficiently large to be legible at the farthest end of the room, and the hours of work should be carefully suited to the age of the child.

The problem of artificial lighting is of vast importance, and it should be remembered that the nearest approach to perfect illumination is that light which most nearly resembles diffuse daylight. Incandescent gaslight or electricity is to be preferred. In reading, the head should be erect, the book about 14 inches from the eyes, with type large enough to be seen at 20 inches, and on a level with the eyes.

Reading at meals or in railway carriages is apt to be injurious, but sometimes its beneficial mental effect may outweigh any possible disadvantages to the eyes. Reading in bed may or may not be a reprehensible practice, according as the rules above mentioned are neglected or adhered to.

Troubles of the Ear.

We have already dealt with the ear in relation to the question of cleanliness, and although we are now concerned with the rôle it plays in fatigue, it will be wise to consider it in its entirety as an effective instrument of hearing.

It is well to remember that the ear in itself does not hear, but only conveys an appropriate form of stimulus to a definite portion of the brain, which is really the perceptive aural organ.

The ear consists of the external, the middle, and the internal portions. The first we will consider in Chapter VIII., in connection with accumulations of wax, and it is only necessary here to add that foreign bodies such as beads and peas should be dealt with much in the same way. They rarely penetrate beyond the soft parts, and can frequently be removed by inclining the head to the side and gently rubbing in a circular manner in front of the ear, or by syringing. Interference of a more active kind should never be attempted by other than a medical man, and it is seldom, indeed, that it is at all urgent to act energetically. Picking or otherwise irritating the ear often results in

the formation of abscesses or boils which may last for years and seriously depress the vitality. This may be entirely obviated by attention to the rules laid down in Chapter VIII. In most cases gentle syringing with a weak solution of borax and lukewarm water, with the puffing of a little powdered boric acid into the external ear, will answer all the purposes of treatment.

The membrana tympani or drum of the ear is stretched between the external and middle ear, serving largely a protective function, although it also acts as a receiver of the waves of sound and conveys them to the internal ear through the chain of little ear bones—malleus, incus, and stapes—connected with it. It is an object of the most intense reverence amongst non-professional minds, its perforation being looked upon as fatal to all hearing; but that this is another popular fallacy is sufficiently demonstrated by the fact that it may be completely absent without the hearing being impaired in any recognisable degree. Indeed, high tones may be heard all the better for its absence, and it is really only a contrivance for shutting out many hurtful influences from the delicate internal ear and brain, and for preventing the undue drying of the contents of the middle ear.

Artificial ear drums, which are constantly being urged on the notice of the public by specious advertisements, are often worse than useless, and, where they are necessary, can be simulated by a little piece of cotton wool fortuitously placed. Not that this is a plea for dispensing with the services of this membrane, because its presence intact is of great advantage to the organism. Care must therefore be taken not to rupture it, which has often been done accidentally by explosions, blows on the ear, kissing on the ear, and even violent coughing, as in whooping-cough. But healing of those ruptures

usually takes place rapidly. The most common cause, however, is rupture of the drum from the inside by the discharge of a middle-ear abscess during scarlet or other fever, and in such an event the opening may last for a very long time and even for life.

The middle-ear which lies inside the drum is the seat of the great majority of ear troubles, extending as it does forward through the Eustachian tube to the throat and backward into the air cells in the mastoid bone. As it is continuous with the throat and nose, it is liable to be involved in the catarrh of these organs, and hence it is easy to understand why a third of the population should be defective in the hearing of one ear. It is lined with a mucous membrane secreting sticky mucus, and provided with little hair-like cilia for propelling it into the throat through the Eustachian tube, which is likewise the agency for the proper ventilation of the middle ear. If this be not catered for effectively, then the cavity will dry up, the chain of bones will become stiff, and the membrana tympani bulge into the cavity, thus impairing its protective powers, and inducing all the internal noises in the head or ear which are of such common occurrence. These are chiefly brought about by the pressure of the stapes upon the inner ear, and it is in this way, or through this medium in any case, that the exhaustion of nervous vitality is apt to take place.

The Din of Civilisation.

When we consider the wholly unnecessary and distracting noises of a large city—the whistles and bells, tramcars and clattering of horses, the street cries of news and other vendors, and the piano organs—and recognise that each one of these imposes a strain upon a little muscle attached to the stapes, called the stapedius, which is therefore more or less always in a condition of

contraction, or at any rate intermittent action, it is not to be wondered that fatigue of the ear and brain is apt to be set up, and that deafness, insomnia, and even insanity are frequently induced by this means. Without mental concentration no effective work can be done, because attention is at the root of all progress, and when this is disturbed by incessant noise of one kind or another the brain cells are apt to have their balance disturbed.

It is quite a common experience for the growth of young children to be stopped because of their residence in noisy localities, being resumed again on their removal to quieter surroundings. The strongest efforts of municipalities and other local authorities should be exerted for the suppression of all superfluous noises, in the interests of the public health.

Noises in the Head.

Tinnitus aurium is the expression usually applied to "noises in the head," and these are often as troublesome as the occasionally attendant deafness. The noises may be of every character—hissing, rushing, roaring, ringing—and have really no definite relation to deafness, as they may persist for years without deafness or be absent when the hearing is defective. They are often due to the presence of a hyper-sensitive nervous system, and may be diminished or relieved by the administration of fifteen drops of dilute hydrobromic acid three times a day in plenty of water after meals.

But sometimes treatment is of no avail and the unfortunate sufferer becomes the victim of constant introspection, with all its risk of inducing melancholia. It is therefore wise never to neglect the simple "colds in the head," which may have such serious consequences. Most of them can be kept at bay by the simple process of cleanliness fully detailed in Chapter VIII. for douching the nose, with now and again the addition of

the following valuable remedy for ear trouble, which a celebrated aurist declared has greatly interfered with his own practice, by reason of its efficacy. It is primarily intended for use in earache, but may be looked upon as a hygienic remedy of value as well in prevention as in cure.

At the first symptoms of earache let the patient lie on the bed with the painful ear uppermost. Fold a thick towel and tuck it round the neck, then with a teaspoon fill the ear with warm water. Continue doing this for fifteen minutes. The water will fill the external ear and flow over into the towel. Then turn over the head, let the water trickle out and pour in some warm glycerine until relief is obtained. The water should be quite warm, but not too hot. Probably if this treatment were adopted at an early stage in all cases of earache more serious mischief would be avoided and fewer "running ears" met with.

The old-fashioned nasal douche is now quite discarded, on account of the risk of fluid passing from the naso-pharynx through the Eustachian tube into the middle ear, and although the danger is not a serious one it is well to be careful in blowing the nose even after the use of a spray or the simple means recommended in Chapter VIII. Indeed, there is hardly any necessity for blowing the nose at all after the use of this simple method, and if it be done just before the face is washed the nose blowing may be altogether omitted. Inflammation of the ear should never be treated lightly, as it may have far-reaching consequences, the source of which is not always suspected. For example, it is not unknown for paralysis of the muscles on one side of the face to arise from pressure of inflammatory products on the facial nerve as it passes through the ear. Probably adenoids

and enlarged tonsils would not be so prone to attack so many young people if a correct diet and proper nose breathing were adopted.

When the toilet of the nose, ears, eyes, and mouth is included in our morning ablutions, and hygienic rules are otherwise followed, the disease so common in these regions will be immensely reduced, and they will even become more tolerant of the many disadvantages of civilised existence. Each one, however, ought to do his best to reduce the evils to which he is at present subjected, and therefore it would be wise, where possible, to live in a quiet neighbourhood so as to avoid as much as may be of discordant noise. Where from any reason this is not possible, one may be reduced to the necessity of plugging the ears with cotton wool to repel the din of city life, and one may contribute one's share to the reduction of noise by wearing rubberettes or rubber pads on the heels, besides diminishing the vibration communicated to the nervous system through the spine.

The benign and soothing, not to say remedial, influence of pleasant concerted sounds upon the ears and nervous system is now well recognised, and provision is liberally made for such gratification in most communities. It may be taken for granted that good music is sought after not so much for the satisfaction of a mere passing whim as, unconsciously, for its therapeutic effect on the body.

Holiday.

An annual holiday of at least three weeks' duration should be considered a necessity, and as many weekends should be indulged in as the exigencies of one's business and the depth of one's pocket will permit.

The primary idea of a holiday is to rest and hence to recreate—that is, to allow time for recreation, of the whole body. It used to be thought that a complete renewal of the whole bodily tissues took place every

seven years. But even the most unobservant knows that such comparatively non-vital and therefore slow-growing structures as nails and hairs renew themselves in much less time. When one considers also that some seven pounds of food and drink are swallowed each day by most individuals, it does not need a very abstruse calculation to predict that a much shorter space of time will elapse during the renewal process, and so accurate a thinker as Dr. Oliver Wendell Holmes has estimated that in any case our most vital tissues are renewed completely once every three weeks. It is therefore desirable that this should be the measure of a holiday, so that, with change of air and change of food, one may rebuild the tissues on a more secure footing once each year.

Just how this holiday should be spent is a problem for each individual to solve for himself, but it is astounding how the average business man fails to employ his business instinct in the consideration of it. He slaves away for months on 'Change in the heart of the City without a single particle of exercise, and then on the 11th of August arrives dead beat at some inhospitable moor in the Highlands of Scotland and at daybreak on the 12th essays a twelve hours' tramp on the hills. It is not to be wondered at that he fails in the attempt, and is lucky if he escapes with an attack of syncope and not a permanently damaged heart.

Walking tours, mountain climbing, and other laborious forms of exertion should only be attempted by those in training. Most people would do well to spend the first week of their holiday—if not in bed stuffing themselves full of wholesome food—at least in an organised attempt at "slacking about," so as to lay in some energy for healthy exertion at a later period of their vacation.

The holiday place should always be chosen carefully to suit the constitution, most people deriving greater benefit from a bracing climate than from a relaxing one, though from the definition one often gets of a "bracing" locality, this is by no means always the case. The seaside is such an attraction for the majority of inland folks that they resort thither without very much consideration as to its suitability or otherwise, and often pay the penalty by going home quite unfit to resume their labours. A week or so on a high, dry moorland place is usually worth a month at the seaside, on account of its stimulating properties on the digestion and metabolism. Obviously, however, the more vigorous and youthful member of society will benefit most from such a place, and the less vigorous and the elderly will find a milder place more suitable.

The climate of this country is so moist even in our driest seasons that a trip to the Continent of Europe or America makes a valuable and agreeable change—chiefly because of the dryness of the atmosphere. Doubtless the change of food and scenery has something to do with the beneficial result, but too much sight-seeing usually ends in a headache from fatigue of the eyes, if no more serious disaster lies in wait.

An occasional week-end is of the greatest value in recuperation of the body, being an unbending of the bow, as it were, though sometimes the same length of time spent in bed will produce much more valuable results.

Practical Summary.

1. Sleep should never be restricted to a definite number of hours, but for the average man eight hours or more should be the rule.

2. Sleep does not attack all the organs of the body simultaneously, but in order,—first the brain centres presiding over the voluntary muscles, then the rest of the brain, thereafter the spinal cord, eyes, and ears gradually succumbing.

3. Sleep is the only time for the nervous system to recuperate, as during all the waking period it is actively functioning.

4. Change of occupation is a rest, but eats into the reserve stock of energy, and so more quickly brings about fatigue. Physical culture or any exhausting exercise before bedtime is usually a mistake.

5. The bedroom should be large, airy, quiet, have its window open night and day, and covered by blue blinds to exclude early morning light.

6. Bed-clothes should be light and warm.

7. The best advice for wooing unwilling sleep is to copy Nature's method by relaxing all the muscles, breathing slowly and in a shallow fashion, and engaging the roving attention on this rhythmical respiration and the relaxation of the muscles.

8. A rest of at least twenty minutes should be taken after each meal in a reclining posture.

9. Fatigue is produced by an increase of the acid waste products in the blood and tissues.

10. Neurasthenia is simply a condition of chronic fatigue, characterised by a tendency to more rapid, though weaker, response to stimuli.

11. The spirit of repose should be cultivated by all, especially those of a nervous temperament, so that energy need not be wasted in useless movements, such as twiddling the fingers, etc.

12. Errors of refraction in the eye, especially astigmatism, produce a great deal of strain and are apt to

induce many morbid phenomena in parts apparently not connected with the eye, *e.g.* headache, epilepsy, constipation, etc.

13. The remedial treatment of eye-strain consists in the possession of appropriate glasses or spectacles, the measurement for which should be entrusted to a medical man practising eye diseases as a speciality.

14. The prevention of eye-strain is equally important, and consists in the provision of proper desks and seats in the schoolroom, proper type for school books, and proper lighting of schoolrooms and houses.

15. Unnecessary noises should be prohibited, as tending to exhaust the nervous force like eye-strain.

16. Artificial ear drums are seldom necessary.

17. Pleasant sounds like music have a powerful influence for good on the body.

18. An annual holiday of three weeks' duration should be taken, as it is calculated that the body renews itself in this time.

19. Occasional week-ends are of great value.

CHAPTER VI.

AIR.

LAW V.—"Live night and day as far as possible in the fresh air."

The Greatest Physician.

THE open air is the greatest disease-preventing and disease-curing agency in existence, and blessed is he whose labours are conducted therein. It seems strange in these latter days, when so much attention is being paid to diet with its three or four meals per day, that air, of which we consume close upon a thousand meals per hour, should not have attracted at least as much attention, especially when we consider that the volume of air we inhale daily is by weight twice as heavy as the weight of all the food and drink we swallow.

A short study of the function of respiration will, however, demonstrate the prime importance not only of pure air, but of a correct method of breathing.

The object of respiration is to supply oxygen for the oxidation or combustion processes carried on in the tissues, and to remove the carbonic acid and other organic excrementitious substances formed as a result thereof. It is of two kinds, or, we might say, it consists of two processes—

(1) External, *i.e.*, the exchange of gases between the external air and the gases in the blood contained in the lungs.

(2) Internal, *i.e.*, the exchange of gases in the capillary blood vessels and the tissues of the body.

The Breathing Apparatus.

The essential organs of respiration are the lungs, which are contained in the thorax or chest cavity, bounded behind by the vertebral column, in front by the breast-bone, beneath by the diaphragm, and at the sides by the ribs. Between the ribs are the intercostal muscles, and these, along with many other muscles, enlarge the chest cavity by elevating the ribs and depressing the diaphragm, and, by this means a vacuum is created, the air rushes in through the nose, trachea, and bronchial tubes, and so the lungs are expanded.

The trachea or windpipe and bronchial tubes are wide tubes, which are unable to collapse because their walls are composed of loops of cartilage connected by muscular fibres. They are lined by mucous membrane containing many small glands secreting mucus, and covered by little cilia or hair-like processes which keep propelling the mucus with its entangled particles of dust towards the mouth. This dust is also in part removed by lymph or adenoid tissue in the tubes, and so carried to the lymphatic glands. As the bronchi become smaller they lose their cartilaginous walls, and are then contained by two layers of muscular fibres, which are apt to be thrown into a condition of spasm and so constitute an attack of asthma. The lung tissue is permeated in all directions by these branching bronchial tubes, which divide and subdivide like the branches of a tree till they are so small and minute that they are as fine as a hair and are hence called "capillary." At the end of these capillary

bronchial tubes are the air vesicles, surrounded and completely enveloped by the minute pulmonary blood vessels, and embedded in the elastic pulmonary tissue. In this dense network of pulmonary capillaries the blood is spread out in a thin layer and only separated from the air in the air vesicles by the thin capillary wall and still thinner air-cell wall, through which it is quite easy for the interchange to take place between the gases in the blood and the lungs.

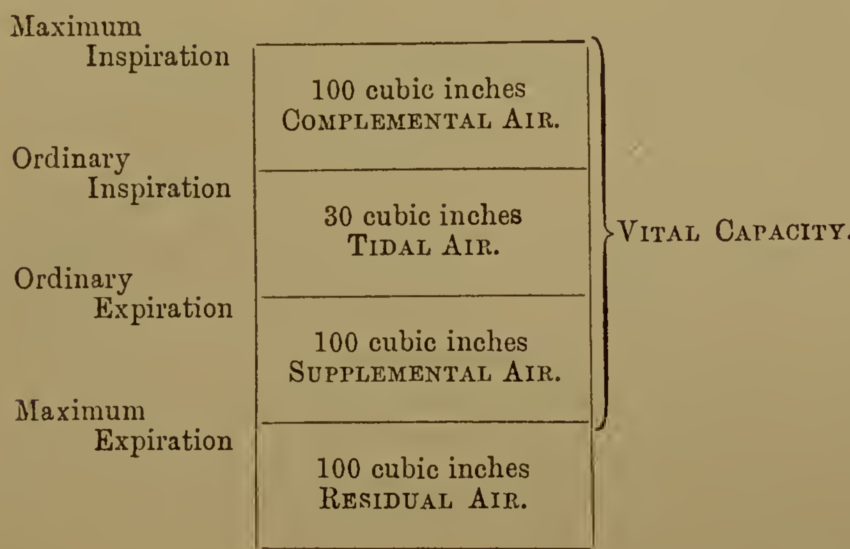
The total superficial area of these air vesicles is said to be one hundred square yards, or practically fifty times the superficial area of the body, and thus it is easy to understand why fairly good health can be maintained even when only one-half of this space is in good working order. The bronchial tubes are themselves a division of the windpipe, and not only branch downwards into the very lowest recesses of the lungs in the back, but upwards into the highest points of the lungs one inch or more above the collar-bone.

The lower divisions of the bronchial tubes are straight, or nearly so, whilst those which turn upwards are spiral.

Vital Capacity.

The mechanism of respiration consists in an alternate expansion of the lungs (inspiration), and contraction (expiration). As the extremely elastic lungs are contained in the airtight box of the thorax they must distend with every dilation of the chest cavity and diminish in size with every contraction thereof. It is impossible, however, to empty the lungs of all their air, as about 100 cubic inches of what is called *residual* air always remains in them. In addition to this, there are 100 cubic inches of air remaining in the lungs after an ordinary expiration, and this is called *supplemental* air. Thus there are 200 cubic inches of air in the chest after an expiration. With an ordinary gentle inspiration

about 30 cubic inches of air, called *tidal* air, may be introduced, whilst by a very deep and prolonged inspiration it is possible to introduce 100 cubic inches more, which is called *complemental air*.



Deep Breathing.

The vital capacity is the quantity of air inspired or expired in the strongest possible respiration, and this, it will be seen, amounts to 230 cubic inches. This quantity cannot, however, be introduced into the lungs without long and careful practice of what is now called deep breathing, a practice the importance of which cannot be overestimated, as eight times more air (and therefore oxygen) than usual is by this means obtained at each breath for blood-purifying purposes.

The two most valuable functions of deep breathing are—

(1) To develop the chest capacity, and hence the lungs.

(2) More rapidly to deplete the blood of its poisonous carbonic acid and organic matter.

It has also been stated that the fairly considerable

excursions made by the ribs in their rise and fall are capable of strongly stimulating the blood-making functions of the red bone marrow; and so deep breathing is a direct incentive to the manufacture of a greater supply of healthy blood. Niemeyer says: "Thirty deep inspirations taken every morning in a pure atmosphere and no tight-lacing will do more for the colour of the cheeks than a tumbler of chalybeate or a dose of iron pills."

One of the most remarkable points noted by a medical man in examining men for life assuranee is the limited power they possess of expanding their chest capacity. The average difference between the circumference of the chest in fullest inspiration and fullest expiration is only two and a half inches, and yet three months' careful and steady practice of deep breathing will increase this margin by as many inches again.

But the average man does not fully utilise even the meagre vital capacity which he has developed, and hence his blood is never really properly ventilated, but retains a great amount of poison. Hence the lassitude and lack of energy so commonly displayed by business men and working men, who are, in fact, being poisoned by their own excretions in quite a similar fashion indeed to the poor wretches in the Black Hole of Calcutta. Morell Mackenzie says: "The process of re-breathing air that has already been used, if long continued, leads to asphyxia and death, but short of this, much so-called 'delicacy,' susceptibility to cold, languor, headache, and nervous depression."

Now, given the power to introduce, say 200 cubic inches of air at each breath, and let this be done even half a dozen times every hour, the result would be an enormous strengthening of the lung tissue, a greater

purity of blood, stimulation of the circulation, and removal of all stagnation and congestion, making it more difficult for pneumonia and other such diseases to enter. With such a chest it would be almost impossible to be attacked by consumption of the lungs or phthisis pulmonalis.

The Chance for Tubercle.

Remember that it has now been well proven that this disease owes its origin to the tubercle bacillus—a germ which is practically universal and ubiquitous, but which is unable to grow or to take root properly unless it can lie undisturbed in its quarters for about eleven clear days. Now, what chance has such a germ to settle in the lungs of an individual who at stated times freely admits nearly eight times the normal amount of pure life-giving air, reaching to the farthest recesses of his lungs? Practically none.

But in a lung which is not fully developed the inspired air takes the easiest course and goes straight through the tubes which offer least resistance—those that branch down towards the back of the lungs—leaving unattempted the more difficult passage of the spiral tubes in the apex of the lungs. It will also be noted that in expiration the air rushing out of the lower tubes in the lung will act as an obstruction to the air which may be passing out of the spiral portions, because the latter has to turn a corner back into the windpipe and the former has a straight course.

It thus comes about that a certain portion of the lung above the level of the bifurcation of the bronchial tubes and in the region of the collar-bone is rarely well developed at all; the lung tissue is non-elastic and badly trained, and the particles of dust or organic matter which are carried in by the air or expelled by the blood are allowed to stagnate and act as irritants to the lung

tissue. Irritation cannot long exist without inflammation being set up, and when this takes place—a condition talked of euphemistically amongst medical men as "bronchial catarrh" or "consolidation"—then comes the opportunity of the tubercle bacillus.

It cannot by any possible chance settle down on the healthy mucous membrane, because not only is this furnished with little hair-like processes called cilia, which are in constant movement towards the outside air, but it is covered with mucus which is kept in constant motion by the cilia, and hence any microbe which may be rash enough to enter the bronchial tubes is quickly floated to the throat, whence it is expelled by a gentle and almost imperceptible clearing of the throat into the open air.

But when even the slightest inflammation is set up in the manner described, then not only are the cilia paralysed, but the mucus is altered in its character and becomes an excellent place for breeding the germs; in other words, a "suitable nidus" has been discovered, and "incipient phthisis" has developed.

The late Prof. W. T. Gairdner long ago taught that quite 60 per cent. of the people who died of diseases other than tuberculosis had evidences of healed tubercle in their lungs, and had thus been victims of phthisis pulmonalis which had been cured in a natural way, proving the eminent curability of a disease usually considered to be incurable. It also proves, however, that the human subject is extremely liable to become affected with tubercle, and it has been clearly demonstrated by experiment that it can always develop in those in whom the vital capacity of the lungs is diminished below the normal. Freund, indeed, has shown that in the first and second ribs of consumptives

the costal cartilages become converted into bone, an evidence that the natural resiliency of the chest cavity has been below par and the lungs have been unable to attain their natural development.

Over-distension.

Many methods have been devised for practising deep breathing, some of which are not altogether free from risk. There is a general impression among medical men that it is quite possible to over-expand the lungs in excessive efforts to develop them, and so to produce an over-distension of the air vesicles and a condition allied to emphysema. This condition is quite normal in old age, because of the degeneration of the elastic tissues of the lungs, and it is easily produced in women, as a result, no doubt, of the restriction in breathing which is caused by unhygienic corset wearing. I am quite convinced, however, that in a normal adult true emphysema is never brought about by any amount of deep breathing,—although, of course, it is wise not to risk even the possibility of an over-distension. When this condition does occur (whatever be the cause), the chief symptom is that the automatic regularity of respiration is disturbed and the individual is compelled to remind himself that it is necessary to take a breath. Such a contingency can always be prevented by remembering that when the inspiration has reached its fullest extent it is unwise to retain the air in the lungs for any appreciable time, but in five seconds at the outside to begin slowly to exhale.

Incorrect methods have been suggested of attempting, by changing the posture, to introduce more and still more air, but I am convinced that these are harmful and will only end in disaster.

A Singer's Prescription.

As correct breathing is also the secret of good singing, the following simple method suggested by Signor Bonci,

the famous tenor at Covent Garden, will be found quite satisfactory and absolutely safe.

Lie flat on the back, with the head directly on the floor and the arms outstretched straight above the head, by this means expanding the four lower ribs. Take a deep breath, extending the diaphragm as fully as possible; then slowly exhale, pressing the air from the bottom of the lungs first, drawing the diaphragm inwards to commence with and upwards at the end until all the air is forced from the lungs, thus expelling the air from the chest as one would empty a tube of paint. By practising the method twenty times each morning and taking as many deep breaths throughout the day, the vital capacity will gradually be increased to a point commensurate with perfectly healthy lungs.

Some people will probably find that this voluntary practice of deep breathing is not only irksome but soon brings about exhaustion, a result not to be wondered at when one considers the enormous number of large muscles brought into activity, without there being at the same time a corresponding natural desire for air. Where a thirst for air (as one might call it) is engendered, as in climbing and swimming, the attendant fatigue is not nearly so great, and such exercises are splendid chest developers.

A Distinction of Sex.

The vital capacity varies with the height, age, body-weight, and state of the health, as does also the number of respirations, which in a normal adult average seventeen per minute, or one for every four beats of the heart.

In females the type of breathing is usually called costal, on the theory that it is brought about chiefly by the raising of the breast-bone and the ribs, whilst in males it is due to the descent of the diaphragm more than to the elevation of the ribs, and hence it is called

the abdominal type. This is the usual distinction of the text-books, but it is open to a considerable amount of doubt, as in many examinations in the nearly nude condition practically no difference is observable.

Probably the apparent difference arises out of the wearing of unhygienic corsets, and can only be noted whilst they are being worn. It is as well that this confusion should be noted, for neither type of breathing is capable of perfectly utilising all the pulmonary tissue, since only those parts of the lungs in contact with the expanding chest wall are brought into action. The whole chest walls should be moved, and likewise, especially in expiration, the abdominal muscles, this being a most important factor in effective speaking and singing.

In abdominal breathing pure and simple the diaphragm is lowered and the chest increased in depth from above downwards, but when the lower ribs are also freely brought into action—what is called by teachers of singing "lower costal breathing"—the depth of the chest is diminished, but the area of the base is greatly increased. It is interesting to note that it has been demonstrated mathematically that the lung contains the greatest amount of air when the lower ribs are raised and the abdominal muscles not bulged out, but slightly drawn in during inspiration. It must be noted that inspiration is entirely a muscular act, and that in ordinary quiet breathing only the diaphragm, the muscles between the ribs, and a few small muscles passing from the spine to the ribs, are brought into action, raising and rotating the ribs and depressing the midriff. During forced inspiration, on the other hand, such as takes place in violent asthmatic attacks, muscles of the trunk, neck, face, and throat are all brought into operation. In ordinary ex-

piration the chest cavity is diminished by the weight of the chest wall and the elasticity of the lungs, ribs, and contents of the abdomen, but in extraordinary expiration nearly as many muscles are used as in inspiration.

Hence deep breathing is really a valuable muscular exercise. In addition, however, it removes a tendency to bronchitis, facilitating the expulsion of mucus and giving the sufferer a peculiar feeling of relief and comfort in the cavity of the chest. It stimulates the liver by squeezing it between the diaphragm and the abdominal wall. It exerts a powerful influence on the stomach, and, combined with the copious drinking of cold water between meals, is an incentive to regular action of the bowels. It benefits the heart by stimulating the circulation, and for the same reason improves varicose veins, and, as elsewhere pointed out, a few deep breaths quickly put an end to blushing, stage fright, and hiccough.

Air—Before and after.

The following table shows the difference between the inspired air and the expired air in 100 volumes:—

Inspired Air Contains.	Volumes	Expired Air Contains.	Volumes
Oxygen	20·81	Oxygen	16·03
Nitrogen	79·2	Nitrogen	79·3
Carbonic acid	0·04	Carbonic acid	4·38
Watery vapour	0·84	Watery vapour, saturated.	
Traces of ammonia-dust and spores and germs.		A large proportion of putrefiable organic matter.	

The expired air is distinguished from the inspired air, therefore, by (1) one-fifth less oxygen, (2) a small quantity more nitrogen, (3) one hundred times more carbonic acid, (4) saturation with aqueous vapour, (5) greater warmth, (6) a large quantity of organic material, which is the dangerous constituent. From 1 to 2½ lb. of

watery vapour are given off by the lungs every twenty-four hours, and about one sixty-seventh part of the body weight of watery vapour is given off by the skin.

It is a common mistake to think that you can suck the air, in breathing, right down to the very bottom of your lungs; this is impossible, as the air only passes into the windpipe and the upper air passages, and then only by diffusion into the lower reaches of the lungs, *i.e.* by a process of commingling, so that the air above and the air below are pretty equally mixed. You cannot increase the combustion in the tissues by the number and depth of the respirations, but you can get rid of more carbonic acid and organic impurities from the lungs and blood, thus preventing the paralysing effect of these poisons on the tissues. External respiration introduces oxygen into the blood, but internal respiration carries it into the tissues, where combustion takes place and the carbonic acid is formed.

The "Inner Circle."

The process of internal respiration is as follows: Oxygen is carried from the air through the walls of the air vesicles into the blood; thence by the circulation to the ultimate capillaries; thence through the walls of the capillaries into the tissue cells; there it combines with the bioplasm, and during metabolism is formed into carbonic acid, which passes through the tissue cell into the lymph space, back through the veins to the lungs, and thence through the air cells into the bronchial tubes and so into the outside air.

Many suspended particles in the air are carried into the lungs, especially if mouth breathing be practised instead of nose breathing. By this natural channel most of the particles are caught by the mucous membrane of the nose, in addition to which the air is warmed and

moistened and so made more acceptable to the air vesicles. The air is moistened by the evaporation of the watery secretion of the mucous glands, and it is said that quite 2 quarts of water are by this means yielded up to the inspired air. This no doubt also aids the rise of temperature of the air, but the important factor in this regard is its passage over the highly vascular mucous membrane, the blood rapidly parting with its heat to the air, so that even at freezing-point it can be warmed by the nose alone to 81° F.

This warming process can be carried out by the mouth as well as the nose, but not so the moistening; hence the dry parched morning tongue and throat of mouth breathers. The sense of smell and the nerves of the nose are also of great value in guarding the lungs from noxious gases and irritating fumes, and so sensitive is this latter mechanism that I have known a case of asthma which arose from inhaling the sulphurous acid fumes in a room which was undergoing the process of disinfection. Mouth breathers are notoriously liable to tonsillitis and other forms of sore throat, bronchitis, and many other chest diseases.

The Sovereign Disinfectant.

Particles of steel are introduced into the lungs of grinders, file-makers, weavers, spinners, millers, bakers, etc., where special precautions are not taken to carry them away by artificial means. Coal and charcoal or soot pass into the coal miner's lungs, producing the condition called anthracosis, and in a minor form into the bronchial tubes and lungs of dwellers in cities, causing the black spit which is such a common feature in the expectoration hawked up from the throat in the morning whilst washing. Micro-organisms of various kinds, *e.g.* diphtheria in the throat, glanders in the nose, measles, and whooping-cough in the bronchial tubes,

pueumonia and tubercle in the air cells, hay monads in the nose are quite common. Proper breathing usually disposes of most of these and others as well, and the smuts in the air are caught up by the white blood corpuscles and deposited in the bronchial glands, where they are more or less harmless. In cities proper scavenging and watering should effectually dispose of most of these troubles; but, after all, healthy nasal and bronchial mucus is the most efficient disinfectant in existence.

Breathing Exercises.

As a fitting conclusion to this section a few exercises favouring deep breathing may be detailed. Ordinary walking, which is after all the basis of most rational exercises, is not of great value in this connection, although when practised in the true heel-and-toe athletic fashion, at four miles an hour, it encourages chest expansion, increases the number of respirations, and if due attention be paid can easily be made a most valuable breathing practice. Walking at a slower pace can be made much more effective from this point of view by placing a stick or umbrella behind the back and through the elbows, and by the adoption of this device gentle climbing backwards, considerably increases the chest expansion. Hill climbing and running are the most notable natural exercises with a reputation for compelling deep breathing, and cycling is perhaps the one exercise least suitable for this purpose. At the close of the section on physical culture a few exercises will be described well calculated to develop the chest, but the three following are suggested as having special efficacy to encourage chest expansion.

(1) Stand quite erect with the heels together and feet at an angle of 45 degrees. First empty the lungs of as much as possible of their supplemental air by bending forward and crossing the arms in front of the body, at

the same time exhaling deeply. Then slowly regain the erect posture, uncross the arms, stretching them gradually out and upwards, at the same time filling the lungs through the nose to their fullest possible extent. Ten or twelve breaths of this description at the open bedroom window every morning during or after exercise will do much to enlarge the chest cavity and develop the lungs. Five seconds may be allotted to the inspiratory and seven to the expiratory movement. Special attention should be paid to the expiration, which should be complete. By degrees it will be quite possible to utilise twenty seconds in inspiration and close on thirty in the expiratory movement. At the end of the inspiration suspend the breath without shutting it completely off.

(2) Stand quite erect as before with right hand on the right hip and left arm raised over the head—the fingers stretching down to the tip of the right ear. Now take a long deep breath, at the same time bending the body towards the right side. This expands the left lung more fully than the previous exercise. The same exercise can be done for the right lung by reversing the arms.

(3) An extremely valuable exercise for expanding the chest, correcting the gait, giving graceful movements in walking and strengthening the erector spinæ—the strong back muscles. Stand perfectly erect, clasp the hands behind the back at full stretch. Thrust the hands forcibly straight down, lifting the ribs as high as possible at the same time. If the chin be held up the result is emphasised. (See Diagram, p. 211.)

The breathing of oxygen for disease or during the process of training should not be lightly undertaken without the advice and direct supervision of a medical man.

Air and Ventilation.

The composition of air, so far as the three gases are concerned, is remarkably uniform all over the face of the globe, even in the open spaces of large cities. This is due to the effects of winds, to the rain which washes dust and organic impurities into the soil, to the action of the oxygen and ozone chemically altering many contained matters, and to the power of green plants, which under the influence of sunlight absorb the carbonic acid in excess, fixing the carbon and setting free the oxygen, although the process is reversed at night, when the plants absorb oxygen by respiration. These influences, together with the diffusion of gases, constitute the science of ventilation. In badly built cities there are many places where the air is de-oxygenated and de-vitalised, the oxygen being reduced and the carbonic acid increased to as much as 0·06 per cent. This is quite common in some parts of London, Manchester, Glasgow, and Birmingham. Only suitable building and town planning laws can prevent this and enable city air to approximate to the consistency of country air. The Atmosphere of Cities.

The air is vitiated by (1) respiration, (2) combustion, (3) decaying animal and vegetable matter, (4) trade processes, (5) poisons from damp soil, etc.

We have already seen the differences between inspired air and expired air. Each person gives off 0·6 of a cubic foot of carbonic acid per hour, or about 30 oz. per day, which may be more than doubled by exercise. The organic matter consists of vapour, epithelial scales, and fatty debris, and putrefies so readily that it may be smelled in a room when the carbonic acid exceeds 0·06 per cent. Respiration.

This is the chief element which is inimical to health, and can hardly be got rid of in rooms even by free ventilation, unlike the carbonic acid which is equally diffused throughout the apartment and quickly passes into the external air when it gets a chance. If enough cubic space is allowed to each inhabitant and the air is sufficiently often removed no injury to health can then arise. Analyses have been made of air in schoolrooms with as much as 0·723 per cent. carbonic acid, or nearly twenty times as much as normal, and as the organic matter increases *pari passu* with the carbonic acid it must have been very foul.

Many diseases are produced by breathing foul air, among them rickets, anæmia, dyspepsia, and phthisis pulmonalis. It is curious that the tubercle bacillus is not at all virulent until it comes in contact with the organic impurity, when it acquires really dangerous properties. This is well seen in back-to-back houses, the inhabitants of which are most liable to consumption. Other ailments arising from foul air are pulmonary diseases and diarrhœa, bronchitis and pneumonia (which may become epidemic), and all forms of infectious disease. Many people cannot breathe foul air without at once becoming affected with nasal catarrh or sore throat, and hospital sore throat, due to long confinement in contaminated air, is well known. It is now known that typhoid fever can be communicated from the sick to the healthy through the medium of the air, as was abundantly proved in the South African campaign.

Combustion.

Ordinary coal burned in an open fireplace gives off three times its weight of carbonic acid and other things, and 1 per cent. of soot and tar. One lb. of coal consumes 240 feet of cubic air. One cubic foot of coal gas produces 2 cubic feet carbonic acid and half a

grain of sulphurous acid. Three hundred grains of oil when burned produce 1 cubic foot of carbonic acid. All these are rapidly diffused in the air excepting soot. Sulphurous acid makes rain acid, destroys vegetation, and disintegrates mortar and the softer kinds of stones.

Carbonic acid in the air, even to the extent of 2 per cent. if unmixed with other ingredients, is not productive of very much harm, but 10 per cent. is fatal. Carbonic oxide is very dangerous even in very small quantity. Sulphurous acid and soot do not produce very much damage, although they are bad for asthmatics and bronchitics. The slightest escape of coal gas is liable to cause ulcerated and relaxed sore throats.

A room heated by a gas fire always contains more carbonic acid than one heated by a coal fire, and in spite of the most efficient ventilation a room always contains more carbonic acid than the external air, probably because it is absorbed by the walls and thus repasses into the air of the room.

The most impure air in a room is at the ceiling, and the purest at the floor.

It is a well known fact that those accustomed to breathing impure air suffer much less seriously from a foul atmosphere than those vigorous healthy people who are accustomed to breathe pure air, and this is a sufficient explanation of the fact that slum-dwellers accustomed to overcrowding from their birth are comparatively exempt from its morbific influence.

Pollution from Decay.

Air which is poisoned from sewers or other accumulations of refuse is not dangerous when diluted, but if inhaled is very risky, and its entrance into a house may cause sore throat, anæmia, headache, and lassitude. Summer diarrhoea in children is due directly to

breathing air and drinking milk contaminated with excretal emanations. It is worst in July and August, and soon after the temperature of the earth at the depth of a foot from the surface reaches 60° F. it begins. The best sewered cities have least of it. City authorities are to be blamed for putting street sweepings in fields near the city, as they are apt to be spread by the wind. The air over marshes contains gases and decaying vegetable matter.

Trade Processes.

The following table, extracted from the Forty-Fifth Annual Report of the Registrar-General, shows the comparative mortality in males twenty-five to sixty-five years of age in certain dust-inhaling occupations from phthisis and diseases of the respiratory organs.

Occupation.	Phthisis.	Diseases of the Respiratory Organs.	The Two Combined.
Coal miner	126	202	328
Carpenter, Joiner	204	133	337
Baker, Confectioner	212	186	398
Plumber, Painter, Glazier	246	185	431
Mason, Builder, Bricklayer	252	201	433
Wool manufacturer	257	205	462
Cotton manufacturer	272	271	543
Quarryman, Stone, Slate	308	274	582
Cutler	371	389	760
File-maker	433	350	783
Earthenware manufacturer	473	645	1118
Cornish miner	690	458	1148
All males (England and Wales)	220	182	402
Fisherman	108	90	198

The evil results of dust-inhalation are seen by comparison with the one dust-free occupation.

Average Mortality in Sheffield from all causes, and from phthisis, and diseases of the respiratory organs during the three years 1905, 1906, and 1907 in certain dusty trades, and among all males over twenty years of age.

Occupation.	Males over 20 Years of Age.	Average Death-Rate per 1000.		
		All Causes.	Phthisis.	Respiratory Diseases.
Grinders . . .	3,375	34·2	16·3	5·7
Cutlers . . .	2,500	40·8	7·2	8·4
File cutters . .	1,850	32·1	4·5	5·4
Silver, etc., workers	2,380	26·9	5·5	4·9
All males . .	127,000	16·2	2·6	2·1

Most houses are full of contrivances for catching dust: cornices, rough wall-papers, carpets fitting into the corners, curtains, even painted walls when dry give off lead dust, and wall-paper frequently contains arsenic and other poisons.

Ventilation.

Ventilation has for its object the removal of foreign gases and suspended matters from the air of rooms. We have seen how the forces of Nature act in the outside air, but as applied to the interior of buildings natural ventilation depends on— The Aim of Ventilation.

(1) Diffusion of gases, which is inversely as the square root of the density, and can take place even through dry bricks.

(2) The winds.
  (*a*) Perflation, as through open windows.
  (*b*) Aspiration, as from chimneys and ventilating shafts.

(3) The difference of the weight of air of unequal temperature as heated air expands. An average adult expires 0·6 of a cubic foot of carbonic acid per hour, and, as the organic content increases *pari passu* with the carbonic acid, the latter being easily measured is taken as the index of the amount of the impurity in air, 1,000,000 cubic feet of fresh air would be required for each individual per hour to keep the air precisely the same as outside air, and this can only be got out of doors. A close disagreeable smell is only felt when the carbonic acid reaches 0·6 per 1000 (0·06 per cent.), and beyond 1·3 per 1000 the odour of the organic impurity is too strong for the sense of smell to estimate it accurately. Up to a content of 0·06 per cent. of carbonic acid, air can be breathed with impunity, and therefore the object of ventilation is to provide enough pure air to prevent the carbonic acid rising above 0·06 per 1000. The permissible limit of impurity is therefore 0·2 of a cubic foot of carbonic acid per 1000. Now, an adult in an absolutely air-tight room, measuring 10 feet × 10 feet × 10 feet, adds 0·6 cubic foot carbonic acid per hour, and this added to what is already contained in the air is equal to one part of carbonic acid per 1000, or 0·4 part carbonic acid per 1000 beyond the limit.

If the chamber has a cubic content of 3000 feet there would be just enough air to last for the hour without becoming too impure, and hence in the smaller room, the same result would be attained by the renewal of the air three times in the hour.

Thus an adult requires 3000 cubic feet of fresh air per hour. Factories and workshops or rooms much contaminated with the products of the combustion of gas require a good deal more. The whole problem of ventilation is therefore to supply each adult with 3000 cubic feet of fresh air each hour without a draught, and naturally for this purpose the larger the amount of cubic space the better. In the colder months of the year it is not easy to obtain the result without draught, as with the air moving at the rate of $2\frac{1}{2}$ feet per second—quite as much as can be tolerated with comfort—48 square inches of inlet are required for each individual.

Most houses depend upon windows and doors for the inlet and chimneys for the outlet. As the expired air is raised to a temperature of 80° F., and therefore ascends, the outlet should be above and the inlet should be below the feet, as the entering air rapidly diffuses through the room. This is precisely what happens in the winter when the fire is burning, but as the result is to produce cold feet it has been found practically necessary to have the inlet above the heads of the inmates. The simpler the device to attain this end the better. The very simplest is Keen's method, which consists in nailing a board from 6 to 18 inches high across the lower end of the bottom sash of the window and raising the lower sash almost to the full extent of this board. There are thus two passages for free entrance of the air which ascends and falls gently into the apartment. Hinckes-Bird's Ways and Means.

system is on the same plan. Without opening the window at all, holes may be bored in the lower rail of the upper sash or window pane. Ventilators may be used, *e.g.* the louvre and Cooper's. The Sheringham valve, Tobin's tube, Ellison's conical brick, Neil Arnott's or Boyle's valves of small talc plates, are all examples of well-known methods applicable to private dwelling houses. One that ought to be specially mentioned, as it ventilates by removing the products of combustion, is M'Kinnell's. After all, however, the handiest, most applicable, and probably the only available method, especially in a bedroom, is the "open window."

Night Air. Winter and summer, the bedroom window should never be closed excepting on the rarest occasions when the atmosphere is polluted by a thick fog, or when the wind is blowing a hurricane.

Night air is much more wholesome than day air, because it is much purer, containing much less smoke and soot and less dust, unless in those unfortunate city streets where misguided corporation officials pollute the atmosphere by their revolving sweeping brush machines. In the same circumstances a closed bedroom window is often to be preferred to the noises of steam and electric trams and other city traffic.

Sleeping in cold air is not at all dangerous if one be properly clad, although it may be so if insufficient protection be not ensured, and especially if cold air plays upon the sleeper's head.

It is dangerous to sleep in an artificially warmed bedroom, where the temperature will seriously diminish before the morning, and some risk is also run in leaving a much heated sitting-room for a much colder bedroom.

The temperature of a bedroom should never be high—never beyond 60° F., and much less than this is more

satisfactory. Excess of bed-clothes and warm impure air, especially if contaminated with the products of combustion of gas, are the cause of disturbed sleep and lassitude on waking in the morning, quite foreign to the individual who has only just enough bed-clothing and a room full of coldish tonic bracing fresh air. There is an idea abroad that the larger the bedroom the less need there is for fresh air, but this is only half a truth. The open window is quite as essential to such a bedroom as a smaller one. It cannot be too often repeated that consumption is not caught by exposure to cold, the truth being that cures are brought about in climates with the coldest but also the driest air. Dust and badly ventilated houses are the real cause of the disease.

Consumption and Window Space.

Only this year Dr. Bernheim of Paris has demonstrated that the death-rate from consumption is inversely proportional to the number of windows per head. In one ward of the city of Paris where the number of windows per head is 4·2, the death-rate from tuberculosis was 1·3 per 1000 inhabitants, whereas in another ward the number of the windows was 1·8 per head, the death-rate was 8·2 per 1000. Persons living in the lower floors were found to be much more liable to tubercle than those in the upper storeys, because they were much less exposed to the sun's rays and had less chance of fresh air.

All sorts of modifications of the open bedroom window have been devised. Sleeping with the bed drawn up to the open window and the head in the open air or without a protection is an excellent plan in a back-to-back house where natural ventilation is almost an impossibility. Where a verandah exists the bed may be placed there or in the garden under a canopy or in a revolving shelter. Tents are not necessarily well ventilated, but when they are they afford a solution of the problem. A more

heroic measure is sleeping quite naked on the ground, and the undoubted advantages sometimes derived are attributable to the open air rather than the contact with mother earth.

Other diseases besides consumption are benefited by the open-air cure, notably that condition of body usually called "nerves" by the public, and which simply means that the patient is poisoned by his own secretions and accumulations of toxic waste matter. Fevers of all kinds are still treated in hospitals, but it has been amply demonstrated that when no indoor accommodation could be had, the cases treated in the open air had a larger percentage of recoveries.

A simple test for excess of carbonic acid in air is that suggested by Dr. Angus Smith. To a sample of the air in a 20-oz. bottle add ½ oz. of lime water, and on shaking it up it will become turbid if the carbonic acid is excessive.

The Effect of Climate.

We have already seen how the body can accommodate itself to all forms of extreme conditions, and we will now glance briefly at the changes brought about.

In hot climates there is no need to manufacture heat, therefore there is less combustion in the tissues or metabolism as it is called, the excreta are lessened, less food is eaten, and digestion and assimilation are at a low ebb. The oxygenation of the blood is diminished because the number of respirations is decreased, and the proportion of oxygen is less in warm than in cold air. The result is very enervating, the skin is particularly active, perspiration much increased, and by evaporation this cools the blood and thus the temperature is regulated. Yet

tropical climates are only unhealthy to Europeans because of the defective sanitation, the water and air being polluted by putrefying substances.

In cold climates all this is reversed. To maintain the heat of the body an abundance of food, especially fatty and starchy substances, must be swallowed; there is increased oxygenation of the blood, and the carbonic acid excretion is increased. The skin acts feebly, and thus less heat is lost by evaporation; a bracing effect is produced, and tremendous energy of body and mind is possible.

In humid climates there is little evaporation from the skin and lungs, and, as this prevents the loss of heat, when the air is hot it is difficult to keep cool. When, on the other hand, the air is cold the lack of evaporation causes a retention of the waste products, and rheumatism is easily originated. In dry climates there is great evaporation from the skin and lungs, and chest ailments are aggravated, the cough especially becoming much more irritating. A warm, equable, fairly moist climate is the one best suited for such ailments. If there is much wind in a dry cold climate the loss of heat and watery vapour is much increased, the skin becomes dry and chapped, the lungs irritated, and especially in an east wind the functions of the liver are disorganised.

Mountain and Sea Air.

In mountain climates there is a greater movement of the air, which is less humid and free from dust and other suspended particles; the atmosphere contains more ozone, and there is increased sunlight and a lower temperature. The soil is rapidly heated by the sun, and thus the days are warm but the evenings become suddenly cool. As the pressure is diminished with increase of elevation there is less oxygen in the air, but the number of respirations is increased, and hence there is greater oxygenation

of the blood, the chest capacity becomes greater, the metabolic activity of the body is increased, and the digestion is improved. For this reason such climates are especially suitable for cases of phthisis pulmonalis in the early stages without bronchitis or much pulmonary congestion, which a cold dry air would only aggravate. If a spot be selected well sheltered from cold winds such cases invariably do well. Mountain climates close to the sea are very damp, and more rain falls because of the humid sea air striking the colder mountain side and depositing its moisture.

Seaside climates are much more equable, and the air is moist, free from germs, and full of ozone. Water heats slowly and parts slowly with its heat. Land heats rapidly and radiates its heat as quickly. Hence in winter the sea gives off its heat, and raises the temperature, and in summer the land gives off its heat, the air over it rises quickly, and during the day a cool breeze comes from the sea. During the night the air is much colder over the land and warmer over the sea, hence the land breeze sets out to sea. It is always cool on the seashore in the summer time, when it is hot and close inland.

Ocean climates are most valuable for lung diseases, such as bronchitis, emphysema, phthisis pulmonalis in its congestive forms, because in these a pure air, free from dust, yet moist and equable is required. Sea voyages are by no means always beneficial to consumptives, chiefly because of the limited accommodation on board ship.

It is notable that cool summers and mild winters are much more healthy than hot summers and cold winters. It is the extremes that tell. An equable climate is much less trying.

In selecting a holiday resort the above principles should be applied, and the following considerations should

FIG. 1. (See page 211.)

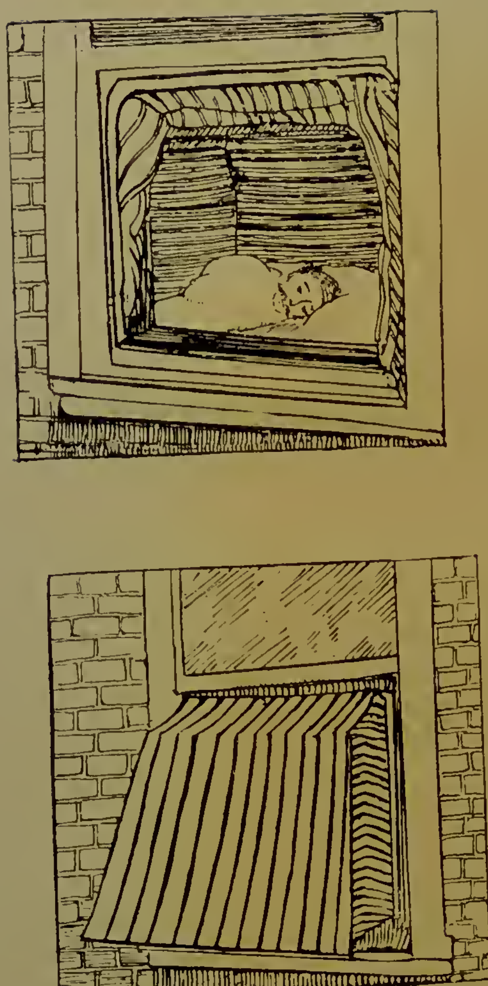


Fig. 3. (See page 211.)—Devices for sleeping in the open air and yet retaining the shelter of the house. Adapted from *Daily Mail.*

Breathing Exercise (3). (Page 198.) From *The Dietetic and Hygienic Gazette*, New York.

be taken into account. The temperament and constitution of the individual should be studied. Thus the nervous and gouty should select an inland fairly high bracing place. If one's place of residence be situated in a cool bracing district it is rarely advisable to select a less bracing resort. In the winter time as a rule the west coast of this country should be preferred, and in the summer time the east coast. The exposure of a health resort is very important; places within a few miles of each other on the seacoast being bracing or relaxing according as they face a northerly or southerly direction. It should be remembered that places in the north of this country are not by any means always bracing. There is some justification for the statement that a change of air is simply tantamount to a change of soil.

Devices for Sleeping in the Open Air and yet Retaining the Shelter of the House.

(1) Bed parallel with the window. After sleeper retires to bed an awning is lowered; the window is then raised. There is a celluloid window in the awning.

(2) Bed endways to the window, the head and shoulders being outside, an external canopy giving them protection.

(3) Bed parallel with the window, a tent-like awning inside over the head and outside to protect from the weather (only used when raining).

Practical Summary.

1. As far as possible live in the open air. Where this is impossible it is wise to make a rule to spend at least two hours in the fresh air each day.

2. Always breathe through the nose night as well as day. Mouth breathing is not only deforming, but dangerous to health.

3. Breathing through the nose filters, moistens, and warms the air in a much more effective manner than when practised through the mouth.

4. Practise sensible deep breathing, not only as an exercise but as a habit.

5. Phthisis pulmonalis, or consumption of the lungs, is one of the most curable of maladies when taken in time. The surest prevention of this disease is the practice of deep breathing.

6. Voluntary deep breathing is sometimes fatiguing and irksome. In such a contingency indulge in climbing, swimming, or other exercise which encourages natural deep breathing.

7. Have at least 1000 cubic feet of space for each inmate of a house or bedroom, *i.e.* a room space of $10 \times 10 \times 10$ feet for each individual.

8. The really dangerous ingredient of foul air is the organic material, which provides food for germs. This can only be estimated by the amount of carbonic acid contained in the air, and this is therefore called the index of impurity of the air.

9. The most impure air in a room is at the ceiling; the purest at the floor. As this obtains even in a burning building, it is wise in such circumstances to keep the head near the floor in endeavouring to effect an exit.

10. The secret of good ventilation is to renew the air in a room at least three times each hour night and day without creating a draught.

11. The bedroom window must be open night and day, but caution must be exercised during foggy weather.

12. Take every opportunity of getting into the

country by week-end trips or Saturday afternoon walks.

13. In selecting a holiday resort, careful attention should be given to the question of climate. Speaking generally, sea air is relaxing and mountain air bracing, but in this country the East Coast health resorts are bracing in the summer, whereas the West Coast resorts when bracing are only so in the winter.

CHAPTER VII.

EXERCISE.

LAW VI.—"Regular exercise should be taken every day, both for recreation and development."

A National Policy.

THE necessity for daily exercise is now tacitly admitted by every intelligent man. The underlying principle involved is simply that of properly using every part of the body. Lack of use means decay, disease, death. The sure road to life and health is that which leads along the paths of physical rectitude. Elasticity is the keynote to the health of every vital structure, and this can only be secured by regular exercise.

The physical nature will thrive in itself and overcome its insidious enemies according to the pains and intelligence with which it is trained and educated for the performance of those ends. The mind is not capable of discharging its functions to full advantage without the most careful preparation for its work, and neither is the body. The physical being has to supply the basis of energy for the intellect and the emotions, as well as to play its own part in the economy of existence. The writer who argued the necessity for spiritual or intellectual culture would be dismissed as preaching truisms. None deny that it is better to educate the mind and the

moral nature than to let them develop in sprawling futility and subject them to the bitter correction of experience. But the soundness of the same plea for the physical side of human nature still requires to be realised. It is admitted in theory, but it is not applied with conviction to the upbringing of the race. The production of health has not been made an object of national policy with the same deliberation as the evolution of intelligence, although, now that our Medical Inspectors of Schools have got seriously to work, it is to be hoped a revolution will take place in this connection.

Much philanthropy is expended in the cure of disease, but scarcely any upon its prevention, except perhaps in connection with the spread of infectious ailments and the enforcement of elementary sanitation. The community recognises the common danger from the malignity of epidemic diseases; what it must be made to realise is the common loss involved in the imperfect development of its individuals. It has a no less substantial interest in fostering physical efficiency than in averting external menace,—that is to say, if the attainment of the maximum of collective happiness, longevity, and working power be admitted as an object of public policy. Upon that basis we need not hesitate to claim for physical culture a place amongst our national responsibilities, and as that place comes to be more frankly conceded the medical oversight now officially associated with education must undergo many and far-reaching developments.

Are we an Athletic People?

All medical experience indicates that as a nation our physical culture is heavily in arrears. It is true that an almost universal worship of sport is evidenced in the popularity of outdoor games, and by the crowds, many thousands in number, who dwell with distended eyes and

bated breath upon the buffeted fortunes of a football. But, scrutinised closely, the football mania scarcely does more for the British Nation than the gladiatorial exhibitions of ancient Rome accomplished for their enraptured votaries. Scarcely 1 per cent. of the average football crowd actually participate themselves in any form of exercise from one week's end to another.

Yet we pose to ourselves and to the world as an athletic nation. Doubtless we have inherited from our ancestors a love for open-air life, and those privileged to be brought up in the country have indulged in outdoor sports, but the city inhabitants, many of whom after all are recruited from the country, are unable to find opportunities to gratify their sporting instincts, and hence their weekly peregrinations to see the old games and the mental delusion that watching is the next best thing to participation. Were this self-deception innocent, little could be said, but in practice it leads too many to abandon all forms of actual exercise, and directs their attention from the true goal of physical culture.

Let it not be supposed that any general disparagement is to be thrown upon the playing of organised games, or upon their educative value to the participants. They afford a training in respect of character, nerve, conduct and judgment, which is hardly to be overestimated, and they are responsible for much of what our nation has achieved in the world. But that stands apart from the special question of physical development, which is here being considered, and in that regard it may be justly observed (1) that games by themselves do not fulfil all that is necessary in the way of physical culture, and (2) that on the physical side the pursuit of athletic proficiency is apt to foster an erroneous ideal of bodily development and perfection.

The object of physical culture is not to people the world with Sandows or Ranjitsinhjis, any more than the object of intellectual culture is to fill it with Herbert Spencers. The object of each is to develop the man upon its own proper lines to his limit of capacity. Each individual is created with a certain capacity for work, and beyond this it is not possible for him to extend his powers without danger. We have the rapid worker and the slow one, the strong man and the weak, the genius and the mediocrity. To apply this principle of variation upon the physical side, we realise that it is only some who can afford to carry their physical culture to an athletic pitch. The true aim always must be to make the man not necessarily strong but healthy—a whole man. It may involve in making him a strong man, but only in virtue of his exceptional endowments.

Physical culture is exercise, but exercise with a purpose and a system to guide it, and its object is to develop each power and organ of the body to its full physiological degree of fitness. To be positively useful, a system of physical culture must be comprehensive, succinct, and capable of easy application. The ordinary forms of exercise with which we are acquainted, such as football and cricket, come within the category of recreation, which is by no means the same thing as exercise for physical culture. The term "recreation" may be taken to define such exercises and sports as do not require any close application of the mind, and indeed they are usually undertaken more as a relief to the mind than as a means of developing the body.

Properly to develop the physical side of man in his growing condition, the most carefully selected system of exercises should be adapted to the needs of each individual, and to retain that equable development in after

life when full growth has been attained, something more than mere recreative exercise is a necessity. Most forms of occupation tend to render a man asymmetrical, to develop some muscles at the expense of others, and by this means to put a strain on the bony framework which has a tendency to interfere with the proper working of the internal organs. For this reason, again, physical education should be attended to in some degree all through life.

A Sad Survey.

The question has often been asked, whether we really inherit symmetrical, well formed, and shapely bodies? It is natural to put a somewhat generous estimate upon our own physique and that of our progeny. But what do the cold insusceptible results of study and research tell us?

In the ten years, 1871–1880, one hundred and sixty-three children in every thousand died in the first year of life, and before another four years had passed no less than another hundred and sixty-three of the thousand had died. In other words, from three to four out of every ten children die before their fifth birthday,—for with all our advances in the last twenty, later statistics show that we have secured no appreciable diminution in child mortality, although intelligent reformers have in isolated cases almost halved this death-rate by the diffusion of hygienic knowledge.

Of the six hundred and seventy-four left from the original thousand, how many are endowed with perfect physical frames? Those of us who are dealing with disease and sickness every day of our lives know what the answer would be. We find many hopelessly deformed, many tainted already with disease from their earliest infancy, many afflicted with weak nervous systems, chests, or hearts, and defective stomachs. In

many classes of society it is hardly possible to find one typically healthy and robust child.

But having found him, if we follow him through his educational career we shall discover that hindrances of all conceivable kinds are thrown in his pathway to prevent the attainment of physiological perfection. Even granted that school children are encouraged to play many forms of excellent games in more or less hygienic surroundings, none of these nor even all combined have the deliberate and guided purpose of building up the pupil for the future, nor have they even the advantage that they can be carried on to any extent in after life. It is the exception at the close of any curriculum open to the masses of the people to find an average endowment of healthy, well-developed bodies. Most of them are round-shouldered and have one shoulder higher than the other, or are hollow-chested. A large proportion suffer from dyspepsia, and carry it with them through life. Much better to have had strong digestions and strong bodies, even at some sacrifice of intellectual progress. This is the judgment which a believer in physical culture must pass on their preparation for life.

Nor does the work of everyday existence render any better service to the stability of the vital parts and functions? Even such a typically healthful occupation as the farmer's tends to make his body irregularly developed. Mowing bends his back, shovelling still more so; ploughing is better, but develops an awkward clumsy gait. Farm work never makes a man fleet of foot. Most of the day some particular muscles are used and get strong, others are never used and must therefore remain weak. Muscles seldom used must of necessity get weak. You have only to go into the agricultural

districts of England to see the clumsiest and most deformed of old men, deformed by their daily labour—a perversion which might easily have been stayed had a few simple exercises been performed each day with a healthy ideal of the body before them, and with a view to the least harmful accommodation of the frame to the various demands of labour.

If farm labour tends to produce a badly or unequally developed man, with all the ensuing penalties of pains in the over developed "muscle-bound" parts—so-called rheumatism—what must we expect of the business man, working in the devitalised air of a city office and hardly ever using his muscles? The broken-down wrecks who visit the doctors' consulting-rooms, with tales of jaded nerves and faces full of woe and apprehension, bear witness, not so much to over-work as to a wrong apportioning of time and energy,—too much being given to the claims of business and too little to the necessities of exercise and fresh air.

Recruiting Revelations.

Nor is the "working man" any better. In all the heavier kinds of skilled labour one side (the right) is developed at the expense of the left, the back more than the front of the chest, and the legs hardly at all. Plumbers and carpenters, coopers and smiths, stonemasons and blacksmiths not only work with one side more than the other, but their tools are usually right-handed, so that they could not well use them with the left hand if they tried to do so.

Only a few years ago Dr. Charles Roberts found that out of 7800 boys and men between ten and thirty years of age who were children of artisans, and out of 7800 who were children of the most favoured class in England—boys at the great schools, military and naval cadets, university and medical students—the sons of the

mechanics, instead of being as tall as the other boys and young men, actually averaged $3\frac{1}{2}$ inches shorter. As to weight, it was found that, at the age of twenty, well-to-do English youths have a mean weight of 18 lb. greater than that of the handicraftsmen living in the large towns. It has also been discovered that the difference between the physical status of the best Scottish agricultural population and that of the manufacturing population of Manchester and Bristol is an average of 5 inches in height and 31 lb. in weight in favour of the former—a pretty striking tribute to the fact that using only a few muscles will make neither large nor strong men.

Small wonder now at the revelation made by the inspection of men volunteering for service at the Cape. More than half of even the pick of the volunteers were rejected—men who could afford the best of food and exercise, but whose work had so unequally developed them that they could not pass the simple test of the War Office. Nor does it astonish one that to make up the proper number of men under the scheme for the increase of the Army the height test had to be reduced or the men would not have been forthcoming. It seems appalling to read that last year, out of the 956 men who offered themselves as recruits in Dundee, 680 were rejected as physically unfit; or that of 1493 in Newcastle 1046 were refused, or that 1821 were rejected of 2523 in Manchester who desired to enter the Army.

These are the fathers of the children of whom so large a proportion die before attaining the age of five. A strong child can rarely be born from a weakly father, and if the latter will not develop himself, his children are likely to suffer. The fact is, that most of us get from our parents a one-sided and partial development,

and, like our parents, are content to leave things as they are. If our daily work does not remedy but increase the defect, few of us seem to have the intelligence to attempt to correct it.

The Human Machine.

To look at the matter more concretely and technically, we find that the human body is a machine of 216 bones, 245 muscles, and numberless joints with which to work the one on the other. A very short description of these three branches of what may be called the locomotor apparatus will increase our interest in the matter, and enable the propositions about to be set forth to be followed more clearly.

Although bones differ markedly in their appearance and shape, their composition is practically identical, as can be proved by two simple experiments.

(1) Fill a flat vessel with strong vinegar or acetic acid and lay a bone therein. Almost immediately some bubbles of carbonic acid gas will be sure to escape, and after a variable time the bone will have lost its hardness and will become quite soft and pliable. In other words, it has lost all its earthy or mineral matter by solution in the acid, and only the animal or gelatinous part has been left.

(2) Burn a piece of bone to a white heat in a fire and allow it to cool carefully. It will then be found to be so brittle that it is liable to crumble away, and it looks indeed like a piece of chalk full of minute holes. This white mass is the mineral matter of the bone, and the little holes are the cavities which were filled with the animal matter or gelatine. It consists chiefly of phosphate and carbonate of lime, and it may be mentioned that these elements are almost quite absent in the bone of an infant, although they gradually increase with each month of the child's life. Hence the bones in early life

are apt to bend, and should anything interfere with the deposit of the mineral matter the bending may be quite serious, as we notice in the disease called rickets.

We are only now beginning to realise the significance of this condition. From the earliest times it used to be attributed to a deficiency of lime in the water or food, and hence water-supplies characterised by extreme softness, such as those of Glasgow and Dublin, were looked upon with grave suspicion. From observation in children and experiments on young animals it is now known, however, that lack of fresh air and exercise are the two main factors in the incidence of this malady, and that when these are supplied in abundance there is little fear of its appearance. A pint of good fresh milk contains more lime than gallons of hard water.

The Uses of the Skeleton.

Collectively the bones are known as the skeleton, which has three functions to perform :—

(1) To serve as a support, especially in the form of the vertebral column, for the erect posture.

(2) To serve as a protection for delicate internal organs, such as the brain.

(3) To furnish a series of levers, as in the limbs, for the muscles to work on.

The skull consists of twenty-two bones, eight in the cranium and fourteen in the face, mostly dovetailed together by immovable jointings called sutures.

The vertebral column is made up of a number of separate bones called vertebræ, and is so constructed as to combine strength, mobility, and elasticity. There are thirty-three of these vertebræ in early life, but as age increases the lower nine join so as to form two bones, the sacrum and the coccyx or tail bone. Of the other twenty-four, seven in the neck are called the cervical; twelve in the back, the dorsal; and five in the loins, the

lumbar. Each member of these three series has characters which enable it to be referred to its own particular set, but all have in common (1) a solid front part or body; (2) an arch springing from the body; (3) one spinous process, two transverse processes, and certain articular processes; (4) notches for the passage of the spinal nerves between the vertebræ. When in position the bodies of the different vertebræ are superimposed one upon the other, separated by discs of cartilage or gristle, to form a column of support, whilst the arches make a continuous canal to lodge the spinal cord and protect it, and the notches afford an exit for the spinal nerves. Besides the cartilaginous discs between the vertebræ there are many ligaments, joints, and muscles, and from the twelve dorsal notches pass off on each side corresponding ribs. This arrangement not only strengthens the spine, but in combination with the various curves which it follows forms a perfect mechanism for lessening jars and shocks.

The Bent Backbone.

When viewed from the side the spinal column presents four curves alternately directed forwards and backwards, —forwards in the cervical and lumbar, and backwards in the dorsal and sacral regions. On the retention of these curves depends the stability of the whole spinal column and in a marked degree the health of the body, because it is on the alignment of the vertebral framework that the correct position of the internal organs and their accurate functioning depends.

At birth the spinal column is shaped like the letter C with the convexity posterior, and it owes its cervical curve forwards to the attitude adopted by the mother nursing her child, the neck usually reposing on or hanging back over her left arm. The first efforts of walking determine the forward lumbar curve, and these two deflections

enable the internal organs to be packed more concisely and with less waste of space in the abdominal and thoracic cavities, and thus most efficiently to perform their functions. We shall see later how a disturbance of the shape of the vertebral column is responsible for much discomfort to its unfortunate victim, besides being the occasion of active disease.

The other portions of the skeleton of special interest to us are the ribs and the shoulder girdle. With regard to the former, every one knows that there are twelve on each side, attached behind to the dorsal vertebræ. The upper seven, called "true" ribs, are attached in front to the breast-bone, the connecting medium being cartilaginous. The 8th, 9th, and 10th are fixed in front to the lower border of the 7th, whilst the 11th and 12th are free in front, and hence called "floating." It is important to note that the ribs which join the breast-bone have their forward ends lower than the rear, so that when they are raised in the act of breathing they push forward the breast-bone and increase their own curvature, thus increasing the depth and breadth of the chest.

There are thirty-two bones in the upper limb, which, being formed for prehensile purposes, has nothing to do with the support of the body, its sole bony attachment being by means of the collar-bone to the breast-bone. The practical point in this connection will be noted when we refer to round shoulders.

Of the thirty bones in the lower limb, special attention will be directed later to the pelvis—made up of the two composite hip-bones, and to the arch of the foot, which is so constructed that, in walking, the external border of the foot alone touches the ground.

A joint is the point where any two or more bones come into contact, and, when typical, consists of cartilage, which coats the ends of the bones, ligaments to bind the bones together, and synovial membranes to secrete the oily fluid which lubricates the joint.

The Meaning of "Tone."

The muscles are divided into voluntary and involuntary, —those under the control of the will, and those over which we have no direct control, such as the heart. We should note particularly the erector spinæ, which is really a composite muscle formed of three columns, the outermost of which is attached to the angles of the ribs and haunch-bone, the middle to the transverse processes of the vertebræ, and the innermost to the spinous processes of the vertebræ. It may also be considered as lying in five layers, the lowest of which consists of quite small muscles between the spine and transverse processes of the vertebræ, hence called spinales, intertransversales, and rotatores spinæ. In naming muscles, the work they have to do, their shape and position are taken into account. Thus those that bend the limbs are termed flexors and those which straighten them the extensors—the one set being antagonistic to the other. The significance of these muscles will appear later, but with this cursory glance we will pass on to the consideration of the mechanism of the body.

To keep this machine in proper working order and ready for useful employment, it is requisite that each part of the body should be properly strengthened, supple, and well supplied with the necessary lubricants, no part being stronger or weaker than in its own due proportion. Nature has ordained that the only method of strengthening, suppling, and lubricating the human machine is by rationally using it. Parts not used become weak, parts properly used become strong.

The two properties of muscles are contractility and elasticity, and the only way to use our muscles is to take advantage of these properties and contract and expand them well. Contraction of the muscles means the movement of the parts to which they are attached, and this can be done by a due and proper amount of exercise of each muscle or group of muscles daily. The habitual use of muscles in ordinary work causes them to acquire an abnormal length, some becoming too long and some remaining too short. This has a direct influence on the bony framework and disturbs the balance of the body. A muscle becomes permanently shortened if it is never fully extended, and permanently lengthened if never fully contracted.

Each muscle by virtue of its elasticity or "tone" has what is called its medium or average length, and the aim of physical culture in middle as in early life is to restore each muscle to its medium length. Muscle "tone" or elasticity is really equivalent to the power of contraction without visible twitch, and the less tone the more excitable and contractile the muscle becomes. This readily explains the quick rapid movements of the subject of nervous exhaustion, the response of the muscles in this condition of "irritable weakness" being more rapid but less effective. Tone of muscle indicates the storage of a reserve of energy, which is lost when the muscle becomes flabby.

Our Unemployed Muscles.

In the wars of muscles, might is right as in the wars of the world. Thus to have a properly proportioned, equably developed body, each muscle must have its daily and proper use.

Now consider that we have two hundred and forty-five muscles, and think for a moment how many are actually used in our daily work,—a few in our legs for

walking, a few in our backs to keep us erect, a few in one or other arm to do our daily work; seldom are any muscles in the chest used, hence the prevalence of flat chest and round shoulders with contracted chest cavities and lungs. None of the muscles in front of the abdomen are employed in the commerce of ordinary life, hence the masses of flesh on the abdominal walls, causing such trouble to their owners in the shape of breathlessness, indigestion, and constipation. Seldom are the muscles on each side of the spinal column equally exercised, and hence the lateral curvature of the spine, the one shoulder higher than the other, and the swinging ungainly gait.

Then, let it not be forgotten that, besides the voluntary muscles of the body of which we have just spoken, there is no organ, with perhaps the single exception of the brain, that is without involuntary muscular fibre, *i.e.* muscle used outside the active control of the nervous system, but lying developed or undeveloped according to the condition of the voluntary muscles. Most of the internal organs of the body are in direct communication through nerves and blood vessels with the skin and muscles of the surface, and it is only through the use of the latter that we can indirectly ensure that our vital organs will be kept healthy.

It was ordained "that man should earn his bread by the sweat of his brow," and so true is this that the man who elects to dwell in a city, where the necessities of life do not compel muscular so much as brain exertion, is bound to become unhealthy unless he adopts some method of so using his muscles daily that he will get the equivalent of the sweating process.

Work is not Exercise.

Many have the idea that in the course of their daily labour they do quite as much work as their energy can

afford, and I am willing to admit that the fully developed man who spends five or ten minutes each morning in brisk free movements, with one afternoon at golf and as many smart open-air walks as he can throughout the week, has all the muscular exertion that is necessary.

But it is a mistake to think that work is in any way identical with exercise. It actually destroys the ideal health or mechanical beauty of the body, as during work the flexor muscles are never fully extended nor the extensor muscles ever fully contracted. In work a man does all he can to save exertion, and rightly so. He aims at saving the contractile efforts used in exercising the muscles, and depends chiefly on the automatic and elastic property which we have before referred to. His brain is engrossed in the object of his work, not in the conscious use of the muscles themselves, and this is the all-important difference.

To exercise a muscle effectively, all the attention of the brain is required to contract it to the full. A muscle is like a sponge, with an important difference. When you squeeze a sponge all the moisture it has absorbed is expelled, but when you fully contract a muscle under the immediate observation of an alert brain, you cause a flow of blood to every part of it, properly nourishing it and carrying nutriment and oxygen to its innermost recesses, so that when it is relaxed the carbonic acid and waste matter produced by its action are squeezed out of it, as the excess of moisture out of the sponge. This is the inspiration or breathing of a muscle, and, when carried out all over the body, it results in a washing of each muscle and organ, so that the result of daily exercise is to wash all the waste matter out of every organ and muscle in the body and thus provide an "internal bath."

To put it in another way, the muscles are the organs in which chiefly is burnt up the fuel supplied in our food. The oxygen we breathe from the air, and the pabulum supplied to the arterial blood by the digestion of our food, are sucked into a muscle by its energetic contraction, and as a result combustion takes place, the muscle being renewed in its tissue by the process, and the ashes thrown off being removed by the venous blood and expelled from the body by the various excretory organs. Too much pabulum or too little exercise leads to "dross" being laid down in the shape of "fat," which acts like "rust" in machinery by interfering with the action of the muscles. Thus Disuse leads to Disease. Most pains in the body arise from the muscular system. Rheumatism, lumbago, colic, cramps in the various organs, asthma, and angina pectoris are all examples of excessive pain producible by excessive contraction of muscular parts, due to disease.

Exercise is thus an absolute necessity for each individual—for the youth in order to full development, and for the adult in order to the retention of that equable development. There may be exceptional individuals who can manage without any or with very little, and there may be some who are damaged by even a little exercise, and of course it is a fact that all are liable to be damaged by excessive or injudicious exercise. But for the typical human being the rule of life is what has been just stated.

Having thus seen the necessity for exercise, let us look for a moment at the valuable effects it produces on the organs of the body. We have already touched on this subject slightly so far as it affects muscle, but we must deal more at length with the effects of exercise upon the muscular system generally, upon the nervous

system, and upon the circulation and the various processes which are thereon dependent.

The Effects of Exercise on the Muscular System.—If you examine a freshly dissected muscle you will find that it presents a smooth surface with rounded outlines and a glistening appearance due to its sheath of connective tissue. This sheath sends down prolongations into the substance of the muscle, and divides it into smaller bundles called fasciculi. Each fasciculus consists of a number of fibres running parallel to each other, and these are again separated by connective tissue.

The Needs of the Muscular System.

The muscle fibre or cell is the ultimate and essential anatomical element of muscular tissue. It consists of soft contractile semi-fluid substance (myosin) contained in a sheath, is seldom longer than $1\frac{1}{2}$ inch, and varies in diameter from $\frac{1}{800}$ to $\frac{1}{1000}$ of an inch. These fibres are arranged in lines of series, and do not communicate one with another. The amount of shortening in a contracting muscle is equal to the sum of the contractions of its individual fibres; and of two muscles equal in cross section, the longer can do more work.

Besides the contractile substance, its tendons, and the sheaths which invest its fasciculi and fibres, every muscle has blood vessels and nerves. Muscle arteries and veins usually lie alongside of each other in the connective tissue which surrounds the fasciculi, and these minute branches or capillaries form a meshwork lying between and upon the fibres, but without penetrating the sheath. Along these capillaries, lymphatic vessels lie also between the fibres and outside the fibre sheaths, and derive their nutrient fluid from the blood vessels on the one hand and their waste material (products of the muscle's action) from the

fibres on the other. A constant stream of fluid is therefore passing from the blood vessels through the sheath of the fibre, and likewise from the fibre into the space between the separate fibres, thus making the so-called "respiration" of the muscle possible.

There are two kinds of nerve fibres in the muscles, those which penetrate the sheath of the fibre and end in its substance (derived from the cerebro-spinal system), and those supplying the blood vessels (derived from the sympathetic nervous system).

Every muscular fibre receives a nerve fibre, and every nerve fibre being in direct communication with the brain nerve cells, each muscular fibre is thus constantly under the control of the brain. When an emotional state, such as fear, produces weakness and trembling in the lower limbs, it is caused by a stimulation of the sympathetic nerves constricting the blood vessels of the muscles and thus cutting off their blood supply.

Dr. Hartwell has compared the action of a muscle to a "peculiarly arranged collection of cartridges loaded with powder and connected with wires by a series of electrical batteries." Each muscle fibre stands for a cartridge, the shell of the cartridge being the sheath and contractile substance, the charge of powder being the nutrient materials in the contractile substance, the wire from the battery being the motor nerve fibres, and the cells of the battery being the brain cells. The electric current is the will power, which, passing from the brain along the nerve to the muscle, gives rise to the phenomena which signalise a muscular contraction. In each case the explosion is followed by the evolution of heat, sound, and motion. But here the analogy ends, for no mechanism has yet been found to re-charge cartridges and mechanically make them ready for firing

again, whereas, so long as the muscle fibres are properly nourished and not too severely stimulated, the muscle cartridges re-load themselves and are always ready to go off on the receipt of a stimulus from the central battery.

A muscle actively contracting uses four or five times as much oxygen as it uses during rest, and it also excretes a much larger amount of carbonic acid, besides a definite though unknown quantity of acid waste matter. This, of course, is the cause of the change in the tissues which is constantly going on, and it is estimated that in one year tissue changes amounting to a ton of material occur in a man weighing 140 lb. Four-fifths of the total heat of the body is produced by muscular action.

The Effects of Exercise on the Nervous System.

The Muscles and the Brain.

The close connection which we have seen to obtain between the muscle cells and the brain cells is of the utmost interest and importance. A surgical section of the brain shows a thin layer of grey matter externally enclosing a core of white matter. The grey layer consists of enormous numbers of cells and minute fibres, embedded in a semi-fluid substance called neuroglia. Most of these cells are of pyramidal shape, with three or more processes or points communicating one with the other and with the nerve fibres. It has been proved beyond the shadow of doubt that these cells, which to a large extent in a newly born infant are more or less rounded, develop the processes and connection with each other and with the various parts of the body, to begin with, as the result of mental action. Exercise of the muscles, therefore, means that more nutriment goes to

the brain cells, as the action of a part always demands a further supply of blood to that part.

Growth, therefore, of brain cells takes place *pari passu* with that of muscle cells, and this is the explanation of the ease with which one performs a difficult piece of work with constant practice. At first the brain cells can only exert their power singly, but after much repetition of the act they generally get associated and act in concert, and the paths of communication between them get wider and easier to pass over. This is the explanation of what is called the "association of ideas"—the real basis of memory, and the reason that after much practice complex muscular and mental phenomena are so easily accomplished. If the body does not get enough exercise, not only is the circulation of the blood in the brain much diminished, but the brain and the nerve substance begin to suffer from degeneration and atrophy, thereafter irritability and abnormal sensibility, nervousness and melancholy soon result.

Effects of Exercise on the Circulation and the Blood.

Exercise and Blood Pressure.

All movements increase the circulation of the blood alike in the arteries, capillaries, and veins. An increased temperature, a pulse increased in strength and fulness and usually in rapidity, and a ruddy suffusion of the skin will readily attest to the truth of this statement. Muscular contraction effects pressure on or contraction of the walls of veins and other blood vessels situated within or in the immediate neighbourhood of muscles. This means at first increased blood pressure. Movements, again, cause an alternate contraction and relaxation of the blood vessels in the neighbourhood of joints,

and this may and does diminish the flow of blood to neighbouring tissues or organs. The blood pressure is inversely as the rapidity of the pulse, and as the flow of blood in the circulation is increased the capillaries become wider and fuller—the blood pressure falls and the tissues are more freely supplied with the needful fluid. The effect of this is seen in various correlated functions of the body.

(1) *The Digestion.*—Here the appetite is increased and there is a greater demand for food, all the digestive secretions are increased in quantity, peristaltic action of the stomach is accelerated and strengthened, hastening the mixing of the food with the gastric juice, and increasing the flow of bile and pancreatic juice. In addition, peristalsis of the bowel is increased, and defæcation much assisted.

(2) *The Absorption.*—This function is carried on chiefly in the small intestine,—only a small percentage of the watery solutions of salts, grape sugar, poisons, and alcohol being absorbed from the stomach. The capillaries and lacteals being more flushed with blood and the muscular action of the small intestine being stimulated, endosmosis, diffusion, and filtration are increased, and a greater volume of the intestinal contents passes into the blood. Thus the demand creates the supply for muscular action, causes increased tissue waste, and this must be made good by materials from the digestive surface.

(3) *The Secreting Organs.*—The saliva and all the other digestive juices, the milk in a suckling woman, and indeed all the products of the secreting glands, are increased by exercise.

(4) *The Organs of Excretion.*—The sewage system of the body has five outlets by which all its waste

matters are ejected—lungs, skin, kidneys, liver, and bowels. Without exercise it is impossible to keep these in healthy working order, but more particularly the lungs and skin. The millions of pores or sweat glands in the latter get blocked up, and the cells of the former become atrophied, and hence a greater share of the work is thrown upon the liver, bowels, and kidneys. All the organs of excretion are benefited by exercise.

(*a*) *The Lungs.*—The effect of exercise here is to increase the amount of oxygen inspired and the amount of carbonic acid expired, as we have already seen in the section upon "Air." The number of respirations being greatly increased, the respiratory muscles are exercised, the circulation in the pulmonary vessels is increased, the lung tissue developed, and the chest capacity greatly augmented. If in lying down we inspire at the rate of one hundred volumes of air per hour, it has been calculated that in gentle walking, four miles an hour, we use five hundred volumes, and by violent exercise we may increase this to seven hundred volumes per hour.

(*b*) *The Skin.*—Exercise causes a dilatation of the blood vessels of the skin and an increased excretion of sweat from its glands, which may exceed 2 lb. per day. This heats the skin itself, but cools the body on account of the evaporation, and of the fact that more heat is given off from a warm surface than from a cold one, and thus the temperature of the blood is never, even by violent exercise, raised more than 1° F.

(*c*) *The Kidneys.*—Exercise increases the flow of urine through the kidneys. The chief cause of this is that the circulation of the blood is increased, and hence the filtration of urine is directly increased, whilst the secretion is only indirectly affected. As so much fluid is thrown off by the skin, thirst is created, and the

satisfaction of this is necessary in order that the increased nitrogenous waste matters and salts provided by muscular activity may be carried off in solution through the medium of the urine. Thus the blood is purified. At the same time the bladder and the abdominal muscles which take part in micturition are strengthened.

(*d*) and (*e*) *The Liver and Bowels.*—As already seen, the effect of exercise is to increase the secretion of bile and peristalsis of the bowel, thus aiding defæcation.

In light of these facts one does not wonder how congestion of the liver, and cancer of the bowels, and Bright's disease of the kidneys should arise. Throw each day a little extra work on each of these organs, either by eating too much or exercising too little, and in time some disease is bound to attack them. If, however, regular exercise be taken daily so as to apportion to each organ its proper share of work and to ensure the regular expulsion of all waste matters from the body, it is much more difficult, nay well-nigh impossible, for the seeds of disease to find an entrance into the body. A good, pure, healthy stream of blood is the best protective against disease germs.

To Fight Deformity.

Even when by carelessness or neglect the body has departed from the normal and the soil is being prepared for the reception of disease germs, the adoption of some sensible daily form of physical exercise is usually the best means of regaining the lost vigour.

Obesity is nearly always the body's vote of censure for eating too much food or taking too little exercise, and it is only necessary properly to balance the income and expenditure in order to keep a well-nourished body. It is important to note that it is usually around those muscles which are rarely exercised in any adequate manner that fat accumulates, *e.g.* the abdominal muscles.

Excessive thinness, again, which is usually brought about by overwork, indigestion, overstudy, anxiety, worry and loss of sleep, is usually caused to disappear by the regular practice of some light system of physical culture, ensuring the removal of all harmful waste matter from the system and the adequate circulation of proper nutriment to all the tissues. For the same reason also, dyspepsia, constipation, insomnia, anæmia, and most gouty and rheumatic troubles can be prevented or cured in their early stages by physical culture.

Probably, however, the most important function that regular exercise serves in the body of even the well-developed adult is to counteract or prevent the deforming results of daily work. We are all more or less deformed. We are not symmetrical. We are right-handed because we use the right hand most, being taught to do so when children, and this is responsible for a slight inclination of the vertebral column in the dorsal region towards the right side. Ambidexterity would be useful, were it only to preserve perfectly accurate alignment in the spine, as there is reason to believe that, although compensation is likely to take place, disorders of various kinds are apt to arise when vertebræ are misplaced. Used parts become strong, unused parts get weak; the stronger pulls against the weaker, and some part is pulled out of the straight. This is no doubt the foundation of most of our asymmetry.

Sins of the School-room.

In most schools, even at the present day, seats without backs, or the merest apologies for such—indeed, worse than none at all—are provided, and to make matters worse, the desks are put at such an angle that the children must bend over them to read or write. The back is thus first curved backward; the shoulders, falling forwards, cramping the free play of the lungs; the left

arm is placed on the desk in writing, the left shoulder advanced, and the right slightly retracted with a little rotation, and so the muscles of the one side pull the spine a little to that side, and lateral curvature is set up. This is again much increased by the constant habit of standing, chiefly on one foot, which is practised very largely at school when children are allowed to stand.

The true remedy for all this is the provision of a seat which will permit a child to rest its spine in the proper position of erectness, and the provision of a desk or reading board on a level with the child's face. An interruption of the study for five minutes every hour or less should also take place, and during this some exercise to strengthen the back muscles should be practised.

If those strong muscles which hold the spine erect and give it lateral support are not strengthened in youth, the ligaments between the bones are stretched, and never resume their health and tone, as they are only provided to limit motion—not to assist the supporting muscles of the frame in doing their proper work. Ligaments are composed of strong inelastic tissue, which, although fairly unyielding, is apt to give way when too much strain is put upon it, instead of dependence being placed on the strong contractile and elastic muscles. Muscular vitality is the proper guarantee that the merely binding ligamentous tissue will not be asked to perform a function it was not meant to exercise.

It is not of any real value to tell round-shouldered people to draw their shoulders back. The shoulder muscles are quite independent of the spinal muscles, and we have already seen that the upper limb in no way depends for its support on the spine. Such action will not strengthen their backs, nor will any kind of shoulder strap or brace be of any use; it will make the wearer

more stiff and ungainly in his motion. The obvious method of correction is not to put a splint on the weak side or any side, but to strengthen the muscles of the weak side and enable them to withstand the pulling of the strong side.

A Word on Chairs.

With such a history in our schooldays and the knowledge that occupations have not a tendency to develop our bodies equably, it has always appeared incomprehensible to me that we have not yet adopted special precautions to ensure a proper posture in our homes. Yet it is seldom that chairs are made which would encourage us to sit properly, so that we are apt to shoot out the lower part of our backs and so put a strain on parts which are not fitted to withstand it. Besides, the straightening in the lumbar curve cannot take place without interfering with the other spinal curves, and so we lose the erect figure which is the pride of man, and approximate to the crawling posture of the beasts of the field.

We should be measured for our chairs, just as we are measured for our clothes. But even when our chairs are quite suitable to the contour of our backbone, we are not content to adopt a correct attitude, but cross one leg over the other in a perversely persistent effort to distort our frames. Whether this is a modern innovation, since the practice of reclining at meals and in reception-rooms was abolished, I cannot say, but it tends grievously to exaggerate the straightening of the lumbar curve, with all its drawbacks, and introduces a new feature in the rotation of the pelvis, with all its stretching of ligaments and pressure upon nerves.

Then again, we walk with protruding abdomen and head shot forward between the shoulders, instead of being thoroughly braced up with the back of the neck touching the upper edge of the collar. A similar sitting

position at table is conducive to indigestion, and, like our sleeping posture, allows some muscles to stretch and others to contract in such a way that to prevent them from distorting our bodies it is necessary to counteract the tendency by physical exercises.

It is proper to add that the recumbent posture, whether in bed or on a couch, is the one position where, without strain of any kind, it is possible to obtain absolute rest. And even this is possible only to those wise and fortunate beings who have learned to relax their muscles, which can be done in this posture without any damage to the ligaments.

When we begin to inquire into the best means for obtaining the valuable effects of exercise we are confronted with many difficulties, not the least of them being the popular fallacy that the true object of physical culture is simply muscle-building.

Such a misconception is the basis of all the so-called systems emanating from the hordes of irregular practitioners and self-styled professors, most of which are calculated to damage the body irreparably. Dumb-bells, home exercisers, Indian clubs, and all other forms of apparatus have an undoubted value in the hands of expert teachers and trainers; but if we are to use any of these at all, let us see to it that only such means are adopted as are consistent with the effective development of the whole man without any possibility of doing harm.

The gymnasium is certainly the ideal place for the efficient development of the body, and the time has come for the public authorities to take the matter in hand and provide unlimited opportunities for the physical instruction of the youth of the nation. Too long has this important matter been left to private generosity and enterprise, with the usual result that a favoured few

have reaped the advantages which rightfully belonged to all. Other countries, such as Germany, Sweden, Denmark, and Norway, have for many years trained not only the children of their schools, but the young men all over the country, in the very best equipped gymnasia, and every visitor to these countries comes away deeply impressed with the immense value which has accrued to the physique of the nation. Whatever truth there may be in the cry that the Government must supply work to the man who is willing to work, there can be little doubt that its chief duty is to give equal opportunities to all to acquire a healthy body. This is the direction which social enterprise must take, and I believe the day is not far distant when every school at least will be supplied with a thoroughly equipped gymnasium under the superintendence of the very best instructors, who will be compelled to keep the institution open till ten o'clock every evening so that all who are willing can take full advantage of its benefits even after they have left school.

With such means at his disposal and such compulsory instruction during his childhood's days, the well-developed man of five-and-twenty would require only to devote, say, five minutes each morning of his life to a few well selected exercises in order to retain the elasticity and vigour he has acquired, leaving an afternoon or two each week for the purpose of recreative exercise.

The Ling System.

The basis of all modern physical culture was laid in 1815 by Peter Henrik Ling, a Swede, who, in a truly scientific method, from an extremely fertile brain, evolved the system which still goes by his name, and was divided by him into four sections:—

(1) Educational—movements chiefly useful in promoting and maintaining normal bodily development.

(2) Medical—used only for curative or preventive purposes, and extensively supplemented by massage.

(3) Military—for the training of soldiers and sailors.

(4) Æsthetic—to give outward expression to thought and emotion.

All systems of physical culture worthy of the name owe their soundness entirely to the principles underlying the Ling system, which has been developed at Stockholm by a host of teachers, who are worthy successors of its immortal founder.

The prime object of athletics and exercise is the improvement of the general health, and no movement in the Ling system is permitted which does not have a beneficial influence on the internal organs. Concentration of the mind on the particular muscles which are being contracted will increase the attendant fatigue, according to the effort of will required. Therefore, persons who are already weak in their nervous organisations, or who are readily tired, should first begin with massage or passive exercise by assisted or resisted movements. It is unwise to drill school children in complex calisthenics. Their young and growing brains are quickly tired by such a tax, and it is much wiser to let them indulge in a romping game in the open air.

Indolent people should concentrate their minds on complicated exercises, such as riding, tennis, and fencing. Neurotic subjects, on the other hand, to whom any form of attention is an effort and may be harmful, should at first practise breathing exercises and then go on to more difficult forms.

Weak patients should at first never be pushed to the

point of fatigue, but later on this may be done with advantage, and indeed without it the greatest good is not possible. It is wise never to hold the breath longer than one can count ten, but it is often a distinct advantage to do it within this limit, as the air becomes warmer and expands, and by this means is driven into every distant air vesicle and exercises it.

The spontaneity of the play of young children and animals is recognised to be necessary for the growth and development of their minds and bodies, and thus from the age of one up to seven, play with very little gymnastic exercise should suffice for all the physical wants of any child.

From the age of seven to fourteen, at least three hours per week of gymnastic exercise should be expected of every child, and this is the best means for the attainment of flexibility of body, beauty of figure, and grace of deportment. Nothing violent should be attempted, but everything kept well within the limits of the child's strength, but at such an age the greatest importance is to be attached to properly regulated exercises. In addition to this, games in the open air in which there is a good deal of walking and running should be encouraged.

From the age of fifteen to twenty-five the gymnastic exercises should continue, gradually increasing in severity and complexity; but at this period the sexes should be separated, as women require a different kind of training from men, because their muscles never become so large or prominent.

From the age of twenty-five to the end of life as much recreative exercise should be taken in the open air as possible, chiefly in the shape of golf, walking, moderate cycling, bowling, etc., and at least five minutes should be spent each morning in undoing the evil effects of the

previous day's work. By this means the body remains graceful and flexible until the very end.

But physical deterioration may be brought about as well by excessive exercise as by too little. Broadly speaking, a community may be divided into two classes, the weak and the strong, and it is absolutely certain that not every weak man can become a strong man, no matter how much exercise he may indulge in. Over-doing it.

Strong men are born, not made. Physical culture may make a weak man strong, but only if he belongs to the strong type. On the other hand, a weak man may nearly always become a healthy man, though it is folly to emulate the professional strong man and expect, even by the most diligent use of certain exercises and apparatus, to approach him in strength; this, unfortunately, does not always become patent until much damage has been wrought to the physical powers, and especially to the heart and nervous system. He whom I have designated the weak man may, like the racehorse, perform in his particular sphere as much and possibly even more work than the so-called strong man, who may be only useful as a beast of burden, like the cart-horse.

The principle adopted in most popular forms of physical culture is that of Milo and the calf—the addition of a little more each day, but as each man has his physiological limit beyond which it is dangerous for him to attempt to increase his physical powers, it is wise to pull up well on the safe side.

It is usual to consider man in his threefold combination of soul, intellect, and body, and the all-round man develops none of those at the expense of the others. It has been said that a man with an over-developed spiritual being is a fanatic; the possessor of an over-

developed intellect, a faddist; and the man who spends too much time in the development of his body, a fool. Every one has a certain allowance of potential energy which he is able, by the working of his body, intellect, and emotional or spiritual being, to convert into so many units of actual or kinetic energy. The more of this energy he expends in one or other of these directions, the less he has to expend in other directions, without at least drawing upon his reserve store. If it were possible to increase our store of potential energy without limit we should correspondingly increase our mental, physical, or emotional or spiritual expenditure of energy in the same degree. But it is only possible to do this to a very limited extent, and hence the fallacy of continually and daily increasing our task in order to make us strong physically.

For the sake of example, let us say that a man has one hundred units of potential energy to expend daily. It stands to reason that if ninety are expended in physical work only ten are left for intellectual and emotional work, and *vice versa*—which is only another way of saying that physical exhaustion causes mental fatigue, and *vice versa.* Now, by whatever standard we elect to measure the energy available for a day's work, it is quite certain it is not limitless, and equally certain that the limit is much more easily reached in the town-bred man of to-day that in the country-bred man of a hundred years ago. Hence the principle of adding a little more each day is most dangerous in practice, on account of the impossibility of knowing precisely how much should be added each day, or of recognising when the proper limit has been reached.

Errors of Athleticism.

Violent exertion can never be useful, and almost always ends in irreparable strain, such as the rupture of

a blood vessel or stretching the heart—examples of which are constantly coming before medical men. An athlete is a bad risk for an Insurance Company, and a big muscular development promotes a condition of premature senility, with often an abrupt and violent termination of life as distinguished from the slow and gradual character of typical senile decay.

Built-up or hypertrophied muscle has a great tendency to degenerate, and this applies to the heart as well as to the voluntary muscles. We must not for one moment confuse physical culture for health with such systems, or with needless and injurious forms of athleticism. Excessive weight, whether of fat or muscle, is not a storehouse of reserve energy, but a burden which demands nourishment if it is muscle, and interferes with nutrition if it is fat. No "over-weight" dies of old age or senility, nor nowadays attains the age of eighty; whereas it is quite a common thing for underweights to live to eighty, ninety, or even a hundred.

The effects of over-exercise may either be constitutional or local, and examples of the latter are quite common amongst those with a neurotic temperament, causing such diseases as writer's, telegraphist's, violin and piano-player's, compositor's, cigarette-maker's, etc., etc. cramp, and appearing in many other forms where prolonged employment of special nerve movements, called for by the occupation or trade concerned, produces spasms in certain muscles which are quite capable of being used normally for all other movements. In the cure of such conditions rest is an important factor, in addition to the employment of massage and even regulated physical culture in the muscles affected.

One has always to pay the penalty of excessively exerting one's muscles, and each sport nowadays has its

deformity, as witness the croquet knee, the tennis elbow, rider's bone, golfer's in-toes, etc. All the exercise needed by the busy man is just that which will make the physical machine run smoothly and evenly. Any amount beyond this, and certainly if a feeling of weariness be experienced after it, is wasting energy and doing the individual harm. Energy is needed for digestion, for thinking, for daily work, and none should be needlessly expended on excessive exercise. The unnecessary breaking down of tissue during heavy exercise makes a man feverish, causes toxæmia or temporary blood poisoning, and strains the heart and kidneys. Hence the feeling of restlessness induced by training in those who call themselves "fit."

If we examine the comparative mortality tables of the Registrar General we find that the men who live the longest are those who are called upon for the least physical output, — clergymen, schoolmasters, grocers, authors, and scientists; and those who die the soonest are largely men whose occupations demand the hardest labour — dock labourers, coal heavers, and general labourers of all classes in industrial districts. It is the air which is the greatest benefactor, and fresh air is more important than muscular effort, bus drivers and cabmen leading sedentary lives in the open air being amongst the healthiest of men. Enough exercise to put all the muscles in play, start the blood moving, and expand the lungs is good, stimulating the assimilation of oxygen and helping the elimination of waste material.

It is said that the Gulf States in the south of North America are full of widows, because the men are up and out all day following the most exhausting pursuits, both in labour and recreation, while the wives sit at home with open doors getting all the advantages of the air

without wearing themselves out. And these women are said to be the most beautiful and longest lived in the world, only taking moderate exercise, but living with the doors and windows of their houses open all the year round. Surely a striking commentary on the gospel of excessive exercise so sedulously preached and practised, and a text for the necessity of a gospel of relaxation.

"Relaxation" the Art of Rest.

Ample testimony to the need of simple relaxation is easily forthcoming. Most observant people must have noticed, during any time they have had for reflection in this hurried life, that even when they are still and at rest they are conscious of an effort of striving, characterised by a feeling of tension or strain somewhere in the pit of their stomachs. I have seen a statement somewhere that this sensation originates in the solar plexus, that Great Clapham Junction of nerves in the neighbourhood of the gastric region, but I am more inclined to think it is due to contraction of some of the muscles associated with respiration. If they will pursue their investigations further and make a few tentative experiments to relieve this strain, they will find that it requires a conscious "letting go" of something in the epigastrium, and this is probably a relaxing of the diaphragm and other muscles in close proximity to it. In any case, a few deep breaths will always be found to be a great relief to the strain, and it is just possible that all the discomfort is produced by shallow breathing, always present in that concentration of the attention known as anxiety, and closely allied to fear.

All this is pretty conclusive evidence that the struggle for existence has resolved itself into a breathless and exhausting nervous strife which is not content with a healthy muscular "tone," but transforms it into a muscular contraction in an effort to get there one

moment before the other competitors. It is a commonplace observation that the business man's face, ay, and business woman and housewife's face, wears an anxious, strained, almost pained expression, indicative of the high tension of the nervous system. This is brought about largely by neglecting to take rest when the time for rest arrives, and by working with more than the amount of force needed to accomplish the end in view.

The nervous system can never be at its best when proper food and recreative exercise, with appropriate rest and economy of force in work, are denied the body. Now, whilst physical culture can do much for us in teaching us how to get the greatest amount of work out of our muscles with the least expenditure of energy, and while recreative exercises like golf and motoring, which are the beau-ideal of fatigue-sparing and fatigue-dispelling forms of recreation—can likewise aid us greatly, there is little doubt that there is room for some method which will teach us how to rest to the greatest advantage. One would hardly think that this was necessary, but when one considers that it is scarcely possible to sit on a chair without inducing some strain in the ligaments and muscles of the body, as we have already seen, the proposition is not quite so surprising.

The simplest solution would appear to be to go to bed whenever a rest was desirable, and there are those who believe that the best holidays are spent in this form of rest. There are many, indeed, who do not believe in bottling up their time for spells of holiday recreation or even rest, but consider that it is much wiser to take this in the shape of shorter and more frequent periods throughout the working day.

Still, we have seen that even rest in bed is not perfect unless we know how to relax our muscles so that they

may obtain their full supply of nerve force and blood without the necessity for any expenditure of energy. They are thus subjected to the most favourable conditions for growth and development.

This relaxing process can only be made to yield the best results by the most assiduous practice, and is different from anything else in our bodily experience, because whilst induced without effort it is an active phenomenon in the sense that it is done under the influence of the will. Each limb or portion of a limb may be allowed to relax by simply giving way completely to the laws of gravity, and the same thing applies to the head and neck, although daily practice is essential to get the best results. Any one who is in the habit of using physical manipulation for therapeutic purposes knows how difficult it is to get patients completely to relax their muscles, and yet, without this, beneficial and remedial results are hardly attainable.

Both contraction and relaxation of the muscles can Massage. be conducted in a passive instead of an active manner by the intervention of a skilled attendant. The former is practised under the name of Massage, which may be defined as the communication of motion to the tissues of the body from an external source, for therapeutic purposes. It consists in kneading, squeezing, beating, stroking, and rubbing the muscular tissues of the body through the skin. This produces a quickened movement of the blood in the capillaries, increased absorption of both blood and lymph, increased secretion, and indeed its effects are entirely identical with those of exercise, with this important exception, that there is no effort of the nervous system involved, and hence no expenditure of nerve force. In cases of exhaustion, therefore, it is calculated to produce a rapidly restorative effect on the

body, which could not be obtained if active exercise were being indulged in. As, however, it could not be carried on for an indefinite period with advantage to the body, it is necessary to pass by gradually increasing modes of effort to complete activity. Hence active movements are first *assisted* and then *resisted*, and so strength is obtained.

Osteo-pathy.

Passive Relaxation of the muscles is performed in quite a different manner, and to explain it fully involves the consideration of the new practice imported from America, and dignified by the somewhat cumbrous and misleading appellation of osteopathy. Its devotees define it as the adjustment of anatomical abnormalities, and to appreciate its significance it is almost necessary to invent a new pathology. Briefly it amounts to this, that anatomical abnormalities, which they call "lesions," produce physiological discord or functional disorder, which may develop into organic disease.

Osteopathic lesions may be: (1) Osseous, *i.e.* an abnormal change of position or relation of the many bony constituents of the body. This may be produced by (*a*) violence, blows, strains, falls, etc.; (*b*) indirectly by atmospheric changes, over-exercise or violent exercise, etc., through the medium of muscle changes; (*c*) reflexly, *e.g.* errors of diet may cause muscular irritation in the dorsal region with contraction of muscles, which again may set up an osseous lesion, and this may in turn cause chronic indigestion. In a great majority of cases these bony lesions are to be found in the vertebral column and the ribs, and consist of so-called subluxations or partial dislocations. These are not measured in inches as surgical dislocations are, but a mensuration in millimetres suffices for the estimation.

(2) Muscular. These may be actual dislocations of

muscle or tendon, but are usually what is designated as "contractured." However inelegant the designation may be, it is certain that in many cases one can feel that certain muscles are swollen, having a doughy feeling, are inclined to pit on pressure, are painful and sometimes hot. This may be caused by (*a*) violence, (*b*) atmospheric influences, (*c*) reflex irritation, (*d*) or be secondary to osseous lesions. Whatever malign effects may arise from them are produced by pressure upon blood and lymph channels, and on the nerves.

(3) Ligamentous, usually secondary to the osseous, and presenting one of two features: (*a*) thickening with adhesions, or (*b*) relaxation.

(4) Visceral, *e.g.* movable kidney or other internal organ.

(5) Composite, *i.e.* affecting osseous, muscular, and ligamentous tissues as a whole, a good illustration being an abnormal curvature of the vertebral column.

Theory and Practice.

Now, nervous tissue and arterial blood are the controlling and governing factors in health, and disturbances of these tissues are necessarily productive of ill-health. On the other hand, the restorative potency of these elements in their perfect state can hardly be overestimated, as witness the achievement of Professor Eric Lexer, of Königsberg, who is reported to have excised the stiff knee of a young woman of eighteen, and replaced it by that of an old man whose leg had been amputated for senile gangrene, *i.e.* mortification due to senile changes. Wonderful to relate, the worn-out knee joint of the old man became part and parcel of the young woman, and underwent a process of rejuvenescence in her body.

Dana says that "the nerve cell is solely dependent on a proper supply of blood, and dies when this is withdrawn, whilst nerve fibres are more dependent on the trophic, *i.e.* nutritive influence of the nerve cell, of which

it is a prolongation." In other words, the preservation intact of the nervous system depends on a normal circulation, and any pressure on blood vessels or nerve cells will vitally affect those tissues which govern and control the life processes of the body.

Now, the osteopath declares that all lesions exert abnormal pressure on blood vessels and nerves. In particular, vertebral and rib lesions exert direct pressure on the spinal nerves as they emerge from the intervertebral foramina, or on the sympathetic ganglia which lie on the heads of the ribs. This causes congestion, inflammation, and degeneration of the nerve fibre, with serious effects on the tissues. He therefore rectifies those lesions, and so claims to bring about the cure of his patients. All other possible causes of disease are in his estimation effects of some lesion, and disappear with the reduction of the lesion, the healing power of nature resident in the tissues being sufficient to restore the parts to the normal whenever it gets the chance.

The "treatment" necessary to this end consists, in the vast majority of cases, in a preliminary stretching of the spinal column from the atlas to the coccyx, and a relaxing of all the contracted muscles along both sides of the spinal column, in the cervical region, between the shoulder blades and in the limbs. The relaxation of the muscles is brought about in two ways: (1) by firm pressure exerted upon the muscle till it relaxes—a slow method only used in acute cases; (2) by separating the points of origin and insertion of the muscle, and thus stretching it. Manipulation of the belly of the muscle itself by pulling it at right angles to its fibres is also resorted to. It is essential for the operator to have a thorough knowledge of anatomy to attain good results, and each region of the body has its own special forms of manipulation. After

this relaxation specific treatment is applied to the lesion by the ordinary rules of surgery: (1) Exaggeration of the lesion, (2) flexion of the part, (3) rotation and pressure.

A perfect cure may be effected by the first treatment, but as a rule subsequent "treatments" must be administered on account of the tendency to recurrence of the lesion, and they should be continued at intervals until a permanent cure has been attained. It is surprising what good results are effected by this method of treatment in the most diverse conditions, but it may be argued that there is nothing very novel in all this, or even that what is novel in the pathology and treatment is by no means true. The osteopath professes to confine his curative measures to manipulation, just as the exponent of the Swedish movement system, the masseur, and the physical culturist, and it is to be noted that each magnifies his office, claiming for it the most extraordinary results and putting forward its practice, by implication at least, as the sole curative method of real efficacy. The distinctive feature of the osteopath is that he claims that all disease is due to displaced tissue, the replacement of which is a prerogative of his own and has as its sequel a perfect cure. So intolerant is he of the idea that his profession is only a branch of the massage or any manipulative or rubbing school, that he is frequently willing to forego all the undoubted advantages derived from relaxing or breaking up an adhesion, etc., and straightway with violence sets about reducing the so-called subluxation, which he discovers in most of his cases.

A Percentage of Truth.

I have had four years' experience of the practice of this method of treatment, and I am willing to admit that excellent results can be obtained by it in the cure of disease. I am convinced, however, that quite 95 per cent. of the cures brought about are due to the prelim-

inary relaxation of the muscles and the breaking down of adhesions. I am furthermore certain that every one of the movements executed for this purpose is simply appropriated from the Swedish system, or is a very close imitation of it, modified so that it can be carried out on a simple couch in one's consulting-room or at the patient's home. I am equally certain that all those cases could have been cured by many other methods. When this has been said, however, I am bound to add that the other 5 per cent. of cures are really brought about by the method which the osteopath claims peculiarly as his own, and that in the past, and I suppose I must add in the present, those cases were neglected, overlooked, and uncured by the medical man, and as a consequence in this country fell into the hands of "bone-setters," and in America into those of the osteopath.

There is a disposition on the part of the orthodox practitioner to regard the detection of "vertebral subluxations" with scepticism. But there must have been some virtue in the methods of "bone-setters," or they would not have obtained patients, and I know that there is some good in osteopaths or five thousand of them would not exist in America, with all the privileges and powers of the medical profession. No amount of theory will convince me that vertebral subluxations are an impossibility, for the simple reason that I not only see them occasionally in my patients, but succeed in rectifying them with substantial results. This is to be specially noted in the case of backache of one kind and another, for which in the past all sorts of massage, hot bathings, and anti-rheumatic remedies have been used with a very modified success. In the great majority of those cases there will be found, on examination, a displacement of one of the vertebræ either laterally, anteriorly, or posteriorly, causing a stretch-

ing of the ligaments and contraction, and therefore pain in the muscles. Small rotators of the spine do not exist without rotation of the individual vertebræ being possible to some extent, and muscles between the transverse processes and spines of the vertebræ argue a possible approximation of those parts to each other.

It is reasonable, seeing that the erect posture is maintained by a distribution of the strain equally over all the joints of the vertebral column, to infer that, when there is a displacement of one of these vertebræ, too much strain will consequently fall upon the ligaments and muscles between it and its neighbours, and, until it is replaced, pain will be likely to arise. In any case, it has been my experience that, when I discovered these lesions and rectified them, discarding all medicines, my patients recovered even after they had swallowed any amount of useless medicine for years. The conservatism of the medical profession has allowed many forms of treatment, like massage, osteopathy, electricity, and Swedish exercises, to be monopolised by irregular practitioners when they should have been captured for the benefit of rational medicine and the good of the public.

During a recent trip to America I had ample opportunity, not only to observe the practice of various osteopaths, but also to converse with them on the possibilities of their work. This experience has only confirmed the views to which I have already given expression. I was glad to find that the highly educated men amongst their ranks disclaimed all idea of discovering bony lesions, *i.e.* subluxations, in any large percentage of their patients, and they were quick to admit that their system was by no means the only method of treatment of value. They inclined to the idea, however, that it suited more cases than any other method, although it un-

doubtedly had its limitations. I was glad to hear this, as the enthusiastic osteopath is apt to imagine it is the only useful mode of treatment yet discovered.

Tension Exercises.

Another method of inducing a favourable influence on muscular condition is what is termed "tension" or "static" exercise, and consists in contracting the muscle group without bringing the points of origin and insertion any nearer. It produces all the good effect of exercise without in any way increasing the tissue waste, or exhausting the nervous system of the heart. A little practice will soon enable any muscle of the body to be "tensed," and a minute may be profitably spent at this method of clearing out the products of fatigue, three or four times a day.

To those who are unable to afford the time or energy for exercise, this method affords an advantageous way of obtaining a feeling of vigour and fitness, much greater than could be expected from its simplicity.

Modes of Recreation.

We are now in a position to consider shortly the best method whereby a business man may get all the value of exercise.

It is to be presumed that in his younger days he has undergone a course of physical culture for development, but, whether this be so or not, from five to ten minutes each morning should be spent in systematic exercise on a plan which will be detailed at the end of this chapter. Its great value consists in the fact that it is composed of relaxing and contracting movements, massage, and active osteopathic movements for retaining the elasticity and correcting any defective positions of the bones of the body.

Meanwhile, it must be said that most men fancy they get a sufficiency of muscular exercise in their daily work, and, if quantity of exertion were the sole consideration,

we should not need to join issue with them on such a statement. Nevertheless (apart from the prescribed course which follows), some recreative exercise will be found of great importance in enabling them to retain their health and activity, both of body and mind. The most natural form of exercise is walking, not only because it is the normal form of progression for human beings, but because in it are employed the largest muscles of the body. From half an hour to three hours should be spent in walking in the open air each day, and if it be not engaged in too soon after a meal, it can be practised in all states of the weather. If in health, it is indeed important that weather conditions should be ignored, as a period of cessation from this exercise is usually followed by disinclination to indulge in it again. It is especially valuable for old men, because there is no risk of straining any of their internal organs, and a love of walking engenders an interest in outdoor life, with all its vitalising influences. At the age of sixty-five the pace should not be greater than two miles an hour, so as to obviate the tendency to heart strain.

Those in good health should endeavour to arrange a fairly long walk once a week, and during the summer holidays, after a preliminary training, a course of walking and climbing will best serve the purpose of re-invigorating the jaded powers of the exhausted city worker.

Walking is the basis of all the really valuable recreative forms of exercise, and so we find that golf, lawn tennis, lawn bowls, croquet, curling, skating, etc., have each their devotees according to their individual fancy. So long as the competitive spirit does not enter too vigorously into the game, the favoured sport will be calculated to intensify all the good effects of the walking or running, which is, after all, the secret of its value.

Cycling is preferred by some, and should be included in the above category, as should also gardening and other hobbies involving physical exertion.

The undoubted value of motoring depends upon a different principle—that of vibration, which stimulates the whole muscular, circulatory, nervous, and lymphatic system, this being a fairly effective substitute for active exertion, whilst the quick rush through the life-giving air encourages deep breathing, and favours the disappearance of the anæmia so common in the town bred.

Horseback exercise is possible only for the few, but combines the value of motoring and cycling with less strain than is incidental to the latter.

Military exercises are a most valuable method of training the bodily powers to their highest state of efficiency, and we may look forward to the time when some form of compulsory military exercise will introduce what is after all the sovereign remedy for the physical deterioration of the people of this country.

Plan for Morning Physical Culture.—About thirty minutes before sitting down to breakfast, and while still in bed, for two or three minutes practise the following movements:—

(1) Remove the pillow from the head, and place it under the small of the back. Then relax all the muscles of the body, limbs, head, and neck in their turn, and remain in that lax position for a full minute.

(2) Whilst drawing a few long breaths, massage with the right hand the front and sides of the neck, so as to improve the development of the thyroid gland, and thus help to postpone that puffiness of hands and face, dry skin, falling out of the hair, and inactivity of mind so common in senile decay, and which are apt to appear long before their necessary time. It is important to

remember that the two pneumogastric nerves pass down each side of the neck, and that this massage serves to stimulate them, and so exerts a wholesome influence on the parts controlled by them—stomach, bowels, etc.

(3) Slowly and thoroughly contract the abdominal muscles from above downwards, thus exerting pressure on the abdominal contents, tending to empty the colon, and removing congestion from the liver, blood vessels, bowels, etc. This should be done twenty or thirty times in succession, and, before beginning, a long deep breath should be taken, and the air gradually exhaled during the exercise, and then the contraction should be sustained for a few seconds during the full and prolonged expiration.

(4) *Massage of the Colon.*—Press the flat of the right hand deeply but gently into the lower part of the abdomen on the right side, and continue this movement throughout the entire length of the colon, *i.e.* first straight up till the ribs are felt, then across the abdomen from the right to left, and then down the left side to the groin. The left hand may also be used in alternation with the right. (This is a capital method for obviating any tendency to constipation.) This exercise may be made more valuable by raising the hips on pillows, a foot above the level of the head.

(5) Slowly but firmly raise the feet until the lower limbs are at right angles with the body, the knees being unbent. Retain this position for two or three seconds, then slowly lower them to the bed. Repeat. (This exercise may be varied by raising the thigh with the knee bent till it touches the chest.)

After performing these movements, jump briskly out of bed, dressed in pyjamas, although in the winter it is wise in addition to don socks and rubber-soled shoes whilst engaging in the following exercises :—

(1) Stand erect—heels together—feet at an angle of 45 degrees—arms fully extended by the side of the body—palms to front. Rapidly bend the forearm on the upper arm till the fingers touch the shoulders. Then allow the arms to fall backward into their original position, in full relaxation. Some may find it easier to do this exercise one arm after the other, *i.e.* alternating the contractions and relaxations. The biceps is the chief muscle involved in this exercise.

(2) Same position. Without bending the elbows, carry the arms strongly as far up and back as possible, keeping them parallel, thus contracting the triceps.

(3) Same position, but thumbs to the front without bending the elbows. Rapidly raise the arms to the side, about a foot above the level of the shoulders, thus contracting the deltoids. The arms should then be allowed to drop back to the sides easily.

(4) Same position as No. 3. Rapidly raise the arms to the side and above the head till the backs of the hands meet. Return to original position, and repeat. Take a long breath as hands are raised.

(5) Same position. Begin movement by swinging arms up to the left side as far as possible, palms outwards, and face in the same direction. Then swing arms in front of the body to a similar position on the right side, keeping the feet firm all the while. The hips should likewise be kept firm as far as possible, for by this means a fuller rotation will be obtained in the spinal column.

(6) Stand erect—arms extended at sides—thumbs to front. Swing each arm simultaneously across the front of the body, bringing it into an uplifted position at the side—upper arms almost at right angles to the shoulders —forearms almost perpendicular, and all the muscles of

EXERCISE 1.—The biceps and other muscles in the front of the upper arm are developed by this exercise.

EXERCISE 2.—The triceps at the back of the upper arm is chiefly developed by this exercise.

EXERCISE 3.—The deltoid muscles which give roundness, support, and protection to the shoulder are developed by this exercise.

Exercise 5.—The chest and muscles of the trunk are not only developed by this exercise, but elasticity of the spinal column—which is the key to all activity—is obtained.

Exercise 6.—This is largely a relaxing exercise, but in addition gives an opportunity for specially deep breathing and all-round chest expansion.

Fig. 1.

Fig. 2.

Fig. 3.

Hay-Tossing Exercise.

Exercise 7.—This develops all the muscles of the trunk, and is especially useful for the full expansion, especially at the apex, of each lung in turn. The weakest people may continue this exercise without undue fatigue for an hour or more.

the upper limb relaxed except those at the shoulder. Repeat by swinging the arms in front of the body, crossing them, and returning to position described. With each movement the knees should be bent, and the back in the lumbar region curved forward as much as possible. A long, deep breath should be taken with each movement.

(7) Stand with the feet apart and knees straight (Fig. III.). Swing the arms round to the left for an impetus (Fig. I.) for the upward swing, by which they will be carried past the front of the body, upwards and overhead. One arm, it will be noticed, is bent at the elbow and falls over the chest, the hand resting upon the shoulder of the opposite arm; the other arm is carried straight upwards and slightly backwards, while the trunk is twisted round somewhat (Fig. II.). Now reverse the movement, bringing the arms to the sides, and relaxing for a moment. Then swing the arms a little to the right to get the impetus to carry them upwards to the opposite side. Repeat the alternate movements until slightly tired, then rest and breathe regularly and fully for a few minutes. (Make the hips firm and tense when the arms are thrown upwards overhead, and relax all the muscles as the third position is assumed. This is important to get the most out of the exercise.)

For this exercise and one or two of the others, and for all the illustrations of the exercises, I am indebted to my friend, Mr. W. M. Scott, Superintendent of the Leicester Sanitarium.

(8) Stand erect, same position as last, but knees lightly bent.

(*a*) Catch back of head with both hands, and sharply press it forwards with a nodding movement, the head and neck remaining perfectly passive in the hands.

(*b*) Hands by side—twist head strongly to the left—repeat the movement to the right side, relaxing all the muscles for a second, and dropping the head forward as the face comes to the front.

(*c*) Rotate head by bending it first backwards, then sidewards, then forwards, allowing it to move about by its own weight, first in one direction, then in the other.

All these movements keep the cervical region elastic, mobile, and free from tendency to adhesions. They should be repeated from six to twelve times each.

(9) Same position as No. 7. Clench fists, and extend arms straight from shoulders to the sides at right angles to the body. Now, keeping arms and upper part of the body in this position, twist the body rapidly to the right, endeavouring to face right about to the back. Repeat the movement to the left. (This movement keeps the dorsal part of the vertebral column elastic and mobile.) The feet may either be kept quite firm on the floor, or permitted to move with the swing of the body. Greater rotation of the spine is allowed by the latter position of the feet.

(10) Same position as No. 8. Clench fists, and push them into either side of the spine at the level of the last rib. Now make the lumbar curve first more concave, then straighten, and repeat.

This frees the vertebræ in the lumbar region, and enables the proper curve to be maintained.

(11) Same position as No. 7. Bend upper part of body somewhat to left side. Reach left hand round to right side at level of twelfth rib, and, whilst taking deep inhalations, rotate the right arm sharply, and at each deep breath press hand on the rib and reach up to the rib above. When the second rib has been reached, reverse the rotation of the right arm, and descend with

EXERCISE 9.—This is a powerful exercise for the development of the trunk muscles, especially those which hold the body erect.

EXERCISE 11.—This is not only an excellent means of developing the chest, but keeps the ribs properly spaced, and the backbone strong and limber. (The body should be bent much farther towards the side than is shown in the plate.)

1st Position.

2nd Position.

3rd Position.

EXERCISE 13.—Excellent for the development of the lateral abdominal and spinal muscles.

Fig. 1.

Fig. 2.

Exercise 14.—This gives full expansion of the chest, and powerful spinal muscles.

EXERCISE 15.—Expands chest, strengthens abdominal and spinal muscles.

the left hand to the twelfth rib again, rib by rib. Reverse hands and process.

(This is an excellent means of keeping the ribs in their proper position and with the requisite amount of space between them.)

(12) Same position as No. 9, but hands outstretched at right angles to shoulders, palms upwards. Without bending elbows, rotate the arms at the shoulders briskly from front to back eight times, and then in the reverse direction. Then, with backs of hands uppermost, repeat the exercise.

Now attend to the preparation of the bath, and complete exercises as follows:—

(13) Same position as No. 9, palms downwards, bend over to the right as far as possible, keeping knees stiff. Then bend the knee and hip joints, touching the floor with the right hand. Rise smartly to first position, and repeat to left.

(14) Kneel on floor, hands on hips, knees nine inches apart, toes turned under. Slowly arch spine backwards as far as possible. Resume position, and repeat. It is important in this exercise to see that the spine is "arched" in its full length, and not simply "bent" in the lumbar region.

(15) Same position as No. 1. Now swing the arms, with elbows stiff, straight above the head. Bend smartly and put the palms of the hands on floor, outside and in front of the toes. Spring lightly backward to the full extent of the body on to the toes. Bend elbows, and approximate the face to the floor. Now straighten elbows, elevate the hips, and regain first position smartly, *i.e.* with feet between the hands. Then spring to "attention," jumping lightly, and bring the arms smartly backward. If this is found to be too difficult at first,

then regain the upright position by stepping out with either foot.

Each of the above fifteen exercises may be repeated from six to twelve or more times according to inclination and strength.

A long deep breath should be taken between each exercise.

Now strip to the skin, use the flesh gloves as directed in Section on "Cleansing," and thereafter take the bath.

Practical Summary.

1. Regular exercise should be taken every day, both for recreation and development.

2. Daily exercise is admitted to be necessary, but is nevertheless neglected. Watching football matches and other forms of athletic sports is not an adequate substitute for personal exercise.

3. During the growth of the body physical culture should be used for development, as also to counteract the evil effects of heredity.

4. As our occupations tend to make us one-sided, a short system of physical culture is wisely continued throughout life.

5. Such a system, to be useful, should be comprehensive, brief, and capable of easy application.

6. The valuable effects of exercise are easily recognised, improving the wind, strength, the digestion, and the mental capacity, and, when not overdone, expelling the acid waste products of fatigue through the skin, bowels, and kidneys.

7. Wrong positions in standing, sitting, and walking are apt to cause round shoulders, lateral and other curvatures of the spine, which can only be prevented by

adopting right positions and strengthening the muscles by exercise.

8. The gymnasium is the right place for teaching the best methods of developing the body, and local authorities should be empowered to build properly fitted gymnasia, and all young people should be compelled to attend them.

9. The basis of all physical culture is the Ling System, which can be adapted to every condition of life.

10. Under the age of seven years, play suffices for all purposes. Between seven and fourteen, three hours per week should be spent in gymnastic exercises. From fifteen to twenty-five, the sexes should be separated, the exercises specialised, and increased in severity. From twenty-five to the end of life, work provides all the exercise necessary, if from five to ten minutes be spent each morning in physical culture.

11. Physical deterioration may be induced by over-exercise. Strong men are born, not made. Emulation of feats of strength often results in a breakdown.

12. One must always pay the penalty of excessive exercise of the muscles. Health is the proper objective of all exercise, and training, not straining, is what we should strive after.

13. Excessive mental and physical tension, with constant strain of business worries and anxieties, create a necessity for relaxing exercises.

14. Massage is passive exercise of the muscles and tissues.

15. Osteopathy owes much of its undoubtedly beneficial effects to passive relaxation of the muscles. It is a valuable method of treatment, especially in deformities and displacements of all kinds.

16. "Tension" or "Static" exercises consist in contracting the muscles without any visible effort.

17. Walking is the basis of all the best forms of recreative exercise, and should be practised in the open air from half to three hours daily. If the spine be well arched according to its proper curves, the lower ribs well expanded, the abdomen well tucked in, the back of the neck touching the collar, it is of itself a perfect form of exercise.

18. A short system of morning physical culture, embracing massage, osteopathy, relaxing and contracting movements, is suggested.

CHAPTER VIII.

CLEANLINESS.

LAW VII.—"A daily bath of some kind is an absolute necessity."

The Ubiquitous Enemy.

THE much-hackneyed phrase, "Cleanliness is next to godliness," no doubt owed its origin to the fact that godliness is only another name for holiness—wholeness or health, and that uncleanliness is absolutely incompatible with health.

The greatest surgical discovery of the nineteenth century was *dirt*, matter in the wrong place, which attacks with detrimental effect every breach of the continuity of the human skin. The greatest medical discovery that will be made in this century will be the accurate details of the morbific ravages of *dust*.

It takes at least two hours in fresh open air each day to counteract the effects of the dust we inhale in dining-room, drawing-room, bedroom, workshop, city street, and country road alike, without estimating the wear and tear of the tissues due to Nature's excretory effort to intercept this terrible enemy. If the human eye had only lenses as powerful as the corresponding parts in the eyes of the common house-fly, we would be horrified to find that not only was our clothing literally saturated with dust, but the skin in every part of our bodies

absolutely coated with a thick layer of this death-dealing impurity. It behoves us, therefore, to study the structure and functions of the human skin, so as to become acquainted with the deleterious effects of uncleanliness, and the best methods to be adopted for circumventing them.

The Two Skins.

The skin consists of two layers—

(1) A superficial non-vascular thin one, called the epidermis.

(2) A deeper, thicker, very vascular layer, called the dermis, or true skin.

The epidermis separates quite readily from the true skin, and is the part which is raised when a blister forms, and which thickens when much friction takes place, forming corns and callosities. Any one who has snipped a blister, or cut a corn, knows that the epidermis is insensible, and this is because it is formed of layers of stratified epithelial cells without blood vessels, and united by a cement-like substance. Four layers may be identified; the outer two being composed of a horny-like substance, and together forming the cuticle, and the lower two being softer,—in the dark races containing pigment,—and called the mucous layer, or rete mucosum.

This pigment is not found in the skin, but is carried by wandering cells from the subcutaneous tissue, and this is the reason that a piece of white skin grafted on a negro soon becomes black. The chief function of the epidermis is to give protection to the true skin, and to prevent it from becoming dry, inelastic, and unpliable. The deeper mucous layer is constantly forming the outer horny scales, and these in turn are continually being shed by a natural process, aided by the friction of the clothes and bathing. This process is easily seen on the scalp of persons who neglect the daily brushing and

shampooing, so essential to its cleanliness, and on the skin of people whose ablutions are too infrequent.

The pigment cells in the deepest layer vary in number, and appear to be formed more profusely under the influence of the sun's rays, so that even among the fair-skinned races tan and freckles are common in the summer-time. Sometimes this pigment-forming function ceases, and patches absolutely free from it appear on the back of the hands, or a condition arises in which no pigment is found at all, this latter being called albinism. The epidermis is pierced by the tubes of the sweat glands and the little pits or follicles in which the hairs lie.

The dermis, or true skin, is quite covered on its surface by little hillocks or papillæ, and on the palms of the hands and fingers and soles of the feet these occur in regular furrows, with grooves between them. These constitute themselves into whorls and other characteristic forms which are peculiar to the individual, and are utilised in some countries as thumb-prints to mark documents in lieu of a signature, and in the police courts of this country as finger-prints wherewith to identify criminals. The epidermis fits accurately into these grooves by sending down prolongations to fill them up. Most of the papillæ contain a looped capillary blood vessel and a nerve-ending, whilst many of them contain specialised touch-corpuscles, which are most numerous on the palms of the hands and the soles of the feet.

It is because of these nerve-endings that sensations of pain, touch, temperature, and pressure are able to be conveyed to the brain, and by means of a delicate instrument it is possible to measure the degree of sensitiveness in each of the parts—the tip of the tongue and the ends of the fingers being the most sensitive

regions of the body. It is impossible to prick the skin with the finest needle without injuring a capillary and causing blood to exude.

Beneath the true skin there is a layer of fat, which gives a roundness to the body outline, and with the skin not only serves as a protection against violence, but prevents the loss of too much heat.

Under the Microscope.

In the true skin are to be found two kinds of glands, the sebaceous, or oil-producing glands, and the sudoriparous, or sweat glands. The sebaceous glands are to be found on all parts of the skin except the palm of the hand and the sole of the foot, and are especially abundant on the face and sides of the nose, back of the neck, and shoulders. They usually open by a duct into a hair follicle, although in some places they open on the free surface of the skin.

They look like small sacs when examined under the microscope, are more superficial than the sweat glands, and secrete a greasy substance called sebum, for the purpose of lubricating the skin and keeping it in a soft and pliable condition.

When the skin is not kept perfectly clean the mouths of these glands become blocked with dirt, and "black-heads" make their appearance, and when these become inflamed by reason of putrefaction of their contents, the unsightly condition called "acne" arises. Without a daily cleansing warm bath, it is impossible to remove the oily layer, with its innumerable microbes which accumulate in the skin, and this is not only a prolific source of disease, but it is the cause of that unpleasant smell associated with dirty people, called the odor humanus. The sebaceous glands prevent injurious friction of opposing surfaces, and generally protect the body from moisture.

The sweat glands consist of little tubes ending in a coil on the under surface of the true skin, and at varying depths in the subcutaneous fatty tissue. The tube winds in a wavy manner through the true skin, and in a corkscrew or spiral manner through the epidermis, where it ends with a free, somewhat trumpet-shaped mouth. The glands are very numerous and large in the palm of the hand, sole of the foot, armpit, and forehead, and the openings of the ducts are popularly called pores.

There are said to be two and a half millions scattered over the skin, and, if placed end to end, they would cover a distance of nearly thirty miles. These glands secrete sweat, although an oily or fatty substance is mixed with the sweat, and serves to lubricate such parts as the palms of the hands and soles of the feet, where there are no sebaceous glands.

The Work of the Skin.

The functions of the skin are: (1) protective; (2) excretory; (3) heat-regulating; (4) tactile; and (5) absorptive.

(1) *Protective*, by forming a covering to the whole body, in addition to which the soft cushion of fat acts as a buffer, warding off external injury.

(2) *Excretory*, and therefore blood-purifying. This is brought about in three different ways:—

(*a*) By actual respiration through the tubes of the sweat glands, it really absorbs a small amount of oxygen, and gives off a small amount of carbonic acid, urea, and salts, varying with the bodily activities. This function is not so important with us as in the case of the "cold-blooded" animals. If the skin of a frog be varnished, or covered with oil, the creature dies sooner than if its lungs were ligatured. If the skin of a warm-blooded animal be varnished, the animal dies after a time, if the temperature be not kept up. This, however, does not

18

take place if the temperature be maintained, and even a human being has been covered with an impermeable coat of tar for the cure of skin disease without any risk to life. It can only have been from the lack of artificial means to maintain the body heat that the little boy who was covered with a coat of gilt and made to take part in a procession in Rome, in days long gone by, met with his death. It certainly was not due to the obstruction of the sweating orifices.

(*b*) By the secretion of sebum. This is composed chiefly of fatty matter, soap, and some salts, and is meant to lubricate the skin and hairs.

(*c*) By the secretion of sweat, which takes place in the coils of the sweat glands. When it is small in amount, it is evaporated in reaching the cutaneous surface, consisting as it does chiefly of water. When, however, the secretion is increased or the evaporation prevented by heavy clothing or excessive humidity of the external atmosphere, drops of sweat appear on the surface of the skin. The former is called insensible, and the latter sensible perspiration. There is 99 per cent. of water in sweat, and the remaining constituents are chiefly fat, fatty acids, and salt.

An average of 40 oz. is excreted in this way every day. The amount is increased by a rise in the surrounding temperature, by muscular exertion, by excessive consumption of fluids, especially hot fluids, and by certain drugs called sudorifics and diaphoretics. When sweating is active, then the kidneys separate less water, and *vice versa*. Hence in summer the urine is concentrated, whereas in winter it is more dilute. Emotional conditions likewise increase the amount of sweat, and this presupposes special nerves controlling the function. When sweating is abnormally increased it is called

hyperidrosis, and this occurs through the influence of the nerves in easily excited persons, chiefly on the head and hands. Sweating of blood is not unknown, and occurs fairly often in yellow fever. Foul sweat, or bromidrosis, is due to the decomposition of sweat brought about by a special microbe, many varieties of which live on the epidermis and fine hairs.

(3) *Heat-Regulating.*—This is effected not only by the evaporation of the sweat, but by radiation and conduction from the skin. When the surrounding air is much warmer than the body, the blood vessels of the skin dilate, free perspiration takes place, and by its evaporation the body becomes cooled. If the air be already full of moisture, this evaporation is very difficult, and we suffer more from the heat than if it were dry. This is a common experience, and also explains why a much higher temperature can be borne in a Turkish bath, where the air is dry, than in a Russian vapour bath. When the air is cooler than the body, the blood vessels contract and prevent the loss of heat, the blood being driven internally to supply more important organs. Of 100 units of heat produced, $2\frac{1}{2}$ per cent. are lost in heating food and drink, the same amount in heating the air inspired, nearly 15 per cent. in evaporation, and 80 per cent. by conduction and radiation.

A Trace of Evolution.

(4) *Tactile.*—The sensations of touch, pain, heat, cold, and pressure reside in the skin, and by the effective exercise of this function the body is enabled to guard against extremes of temperature, and in all sorts of unconsciously delicate ways, most of which have become quite automatic, to ward off external dangers. Dr. Louis Robinson has pointed out that the most sensitive parts of the skin owe their character to evolution from the days of primitive man, and can be traced to the

necessity for guarding our most vulnerable points, situated as they are in the armpits, region of the ribs, groin, and back of the knees.

(5) *Absorptive.*—After a long immersion in water, the superficial layers of the skin become much swollen, but they are unable to absorb any substance, even in the form of a watery solution. When the fat in the epidermis and in the pores of the skin is removed by alcohol or ether, then absorption may take place. Iodine, carbolic acid, and other irritant drugs are absorbed only by virtue of the power they have of destroying the epidermis. Ointments containing medicaments, when thoroughly rubbed into the skin, are absorbed because they are pressed into the pores, and so gain an entrance into the circulation. Minute traces of oxygen, carbonic acid, and other gases can be absorbed by the unbroken skin.

From such a bird's-eye view of the ultimate structure and functions of the skin, we are in a position to estimate the overwhelming importance of cleanliness. Hardly any of the skin's functions can be efficiently performed without the removal of all foreign matter from the surface of the body, and it is easy to understand what a direct influence this must have upon the health of the whole body. Its indirect wholesome influence is, however, no less valuable because irritation of the skin by dirt, excess of sebum, sweat, and microbes, is capable of bringing into activity internal reflexes which are apt to produce disorder of the secretions of the alimentary canal, and probably still more serious effects.

We are now ready to inquire into the most efficient means for bringing about this cleanly condition. These can practically be divided into two classes of treatment: (1) friction and (2) bathing.

The value of friction cannot be emphasised too strongly, especially when it is effected with a good sound pair of horsehair gloves or a strap. As a rule they are used as a preliminary to a bath, and, when applied in a proper manner, it is astonishing to see the amount of dead epidermal scales which can by their means be removed from the skin. It is well to use method in their application, and therefore the left arm should first be rubbed, then the chest and abdomen, back and right arm, followed by the left leg, and thereafter the right leg. By this means the whole superficies of the skin can be gone over very nicely by the use of the gloves alone, and it may be repeated a second time and even a third time with great advantage, till the skin is glowing with heat, and suffused with a healthy scarlet flush. *Friction.*

Considerable muscular and respiratory effort is demanded for this operation, and if carried out in the morning, after a few minutes of brisk Swedish movements, practically no other exercise for development is required of the full-grown man. As it is necessarily conducted in the nude state, the body is all the time enjoying an air bath, the tonic effect of which is considerable. The feeling of lissomeness, agility, and general *bien-être* after such a friction air bath must be experienced to be understood, and for many people who are unable to obtain a bath, or to whom it is medically forbidden, the process makes a very good substitute.

Friction can, of course, also be employed in the bath by means of brushes, loofahs, and other well-known means, but the bath is of infinitely greater value when it has been preceded by thorough friction with a good pair of horsehair gloves.

A slow, tedious, and sometimes painful combination of

air bath, cold water bath, and friction is performed by certain "Nature-cure" enthusiasts. They sit in 3 inches of cold water, lave this all over the body for two or three minutes, and then, standing up, rub the whole body dry by simply using the hands without any towel. To carry out this procedure aright takes the best part of an hour, and is no doubt more valuable than a cold bath preceded by friction with the gloves. It is often fairly exhausting, and is not free from the risk of catching cold.

Bathing.

he Cold Bath a Blunder.

So far as the maintenance of health is concerned, bathing usually resolves itself, with people of well-regulated lives, into a morning cold bath, a weekly hot bath, an occasional Turkish bath, and an annual course of sea bathing.

A daily bath of some kind is an absolute necessity, but there is a grave doubt as to whether the usual reputedly bracing and tonic cold morning bath is not a serious error, and only to be classed among the stimulants which do not impart vigour, but only excite its display. In any case, it lacks the most important factor of being a cleansing agency, which requires hot, warm, or tepid water, a good scrubbing-brush, and soap.

The action of a cold bath is to constrict the blood vessels of the skin, and drive the blood to the internal organs. The respiration is greatly increased in depth and at first quickened, the frequency of the pulse is lessened, and the temperature somewhat lowered. The whole nervous system is immediately and powerfully stimulated, and, on emerging from the bath, if reaction takes place, the tiny arteries dilate, the skin flushes, and the bather experiences a sensation of warmth and general

well-being. This reaction may be much encouraged by the use of friction with rough towels, and the exercise necessary to manipulate them.

I have no doubt a morning plunge in cold water has a bracing or tonic effect on most strong young men, but in principle a tonic is quite wrong, especially in the morning—the time when, on account of our long night's rest, we stand least in need of it. A tonic is in the nature of a stimulant, and he who indulges in this luxury must be prepared to pay the penalty, which sooner or later is demanded of all.

We are constantly hearing of the reaction which it is necessary to obtain after a cold bath, and the explanation is given that we must have a healthy glow all over the skin just after the plunge. But this is a most fallacious test. There are very few who do not experience this feeling of delight and pleasurable glow all over the skin just after the plunge, but the true test of the suitability of the bath is to feel this healthy glow *all through the day.*

Now, for one who fails to get the so-called reaction immediately after the bath, there are dozens who do get it, and yet feel tired, depressed, cold, and irritable three or four hours after. They never associate those unpleasant feelings with their morning cold bath, though they are decided indications that the dangerous stimulant should be dispensed with. It is not uncommon to find people who, relying on the pleasurable afterglow, and ignoring the subsequent drowsiness and discomfort, continue the bath when it has begun to do their bodies serious harm. The truth is, that most city people in these days have had all their reserve force abstracted by their daily work: they forget that a stimulant or tonic adds nothing, but, after a temporary fillip, actually

subtracts much nervous force or energy from their bodies which they are not in a position to afford.

This drawback to the cold bath would be removed were a preliminary hot shower or douche taken to warm the body thoroughly. Where this is not available, the only alternative is to adopt a milder form of morning bath which may yet be quite capable of producing a pleasant afterglow without any of the exhausting effects of the cold water. I believe, however, that many of the people who find the cold bath produce some of these unpleasant after-effects would be able to tolerate it, if they initiated the process with a thorough horse-hair glove friction. The ordinary cold bath, of course, is better than none at all, but a preferable substitute is to be found in the shower bath, especially if preceded by a hot shower, and that again by friction.

The Hot Bath at Night.

Perfect cleanliness, however, cannot be obtained by any of these means, as the oily coating of the skin cannot be properly removed without heat. The warm bath in some shape or form is necessary for this purpose, and it is all the more valuable if it be taken in a full reclining position. The high temperature (90°–98°·4 F.) of the water melts off the fatty layer from the epidermis, the dead layers of which become swollen up, the tiny arteries dilate, the pulse and respirations are increased in frequency, and the temperature is raised, and, if continued long enough, perspiration takes place. The flushing of the skin with blood means that the internal organs are depleted, including the brain and other vital parts, and thus, if the water be too hot, fainting is apt to occur.

The general effect of such a bath, continued for fifteen or twenty minutes, is soothing, and hence after a hard day's work or exercise, when the muscles are sore and

aching, or when internal colic or cramp is threatening, it is a most valuable agency, being followed by a tendency to sleep. A warm bath on the way to bed is, therefore, highly commendable. Friction in the bath or during the process of drying facilitates the removal of the dirty pellicle and the dead epidermal scales on the skin.

It is always an advantage to apply cold water after such a bath, and, indeed, the order in water application should always be warm first and then cold. The cold douche should be of short duration, and not sufficient to dissipate the heat which has been stored in the body by the application of the warm water. Any lassitude which may have been caused by the heat immediately vanishes with the cold affusion, and even if there be nothing bracing or tonic in the warm bath, its general result is by no means of an exhausting nature, but productive of vigour and virility.

The well-trained athlete of Japan would scout the idea of taking a cold bath, whereas he absolutely revels in the excessively hot bath, taking one at least every day, and staying in for one or more hours on each occasion. He certainly does not intend that they should exhaust his energies, as a wrestling bout is often both preceded and followed by such a bath, and there can be little doubt that the removal of waste matter both from the skin and the tissues generally is productive of the greatest vigour to the whole body, and precludes the necessity for the so-called tonic effect of the cold bath.

A Useful Compromise.

For the great majority of people, especially in the morning and after exercise, the following *combination bath* will be found the best form of introduction to the duties of the day. All that is necessary is to ensure

the supply of a gallon of boiling water in the morning, and to this is added a sufficiency of lukewarm or coldish water from the bath taps until about 3 inches of water lies in the bath. Then with this, a pair of loofah gloves, and a little superfatted soap, the skin from neck to toes should be thoroughly scrubbed and cleansed. The operation should only take about a minute, and then a few handfuls of really cold water may be splashed over the skin, and, jumping out of the bath on to a cork mat, the body may be enveloped in a large Turkish towel, and thorough drying and friction take place without the risk of a chill.

The use of soap, like every fixed habit of ordinary humanity, has been decried by the Nature-healer with insufficient authority. It may be admitted that when used in excess, or of an inferior quality, bad results are likely to ensue; but, on the other hand, perfect removal of the fatty pellicle of dirt cannot be effected without soap. Friction is doubtless of great value, and for the morning combination bath the addition of common salt on the loofah instead of soap materially increases the friction, so that the cleansing effect attained is greater —even if no other benefit accrues—than without it. But the popular faith in soap is not misplaced, and in any case it must be used in the warm bath.

Soap owes its value to the fat and alkali contained in it, and it is better to have the former in excess than the latter. Free alkali, indeed, is harmful to the skin, causing chafing easily and acting as a mild corrosive, and it is probable that the fat is the valuable agent in dissolving or at least emulsifying the oily substances on the skin. For this reason it is necessary to be sure of the origin of the fatty basis, and there are grounds for believing that a vegetable is better than an animal one,

and is much more likely to be pure. A superfatted soap is useful, and, if made from cocoa-nut oil, lathers freely, and can be used with salt water. "Scented" soaps, "medicated" soaps, "antiseptic" soaps, and so forth have no properties of exceptional value.

Turkish baths are valuable if not indulged in too hot. When in residence at a hydropathic, a short course of three or four taken in the morning at a moderate temperature, and prolonged for only twenty minutes, is one of the most valuable tonics in existence, by reason of their extraordinary cleansing effect, and removal of waste matter from the system. They are specially valuable to the rheumatic subject, but there are grave doubts as to their efficacy in breaking up a cold, at least in its early stages. On the other hand, on account of the numbers who resort to them under this belief, the Turkish bath chambers are usually the haunt of the Micrococcus catarrhalis and other allied species of bacteria, so that more people catch colds in such places than are cured of them.

The Time for Sea Bathing.

The efficacy of sea bathing depends not so much on the salt as on the pleasurable exercise associated with it, the fine ozone-laden air in which it is carried on, the motion of the waves breaking against the skin, and the fact that it is indulged in when the mind is free from business cares and on holiday bent. The popular belief that one cannot come by any harm when in contact with sea water is answerable for the loss of many lives annually. Over-exposure to cold, whether by staying too long in the sea, or paddling too long on the beach, or getting wet in a little boat, will be followed by the same penalties as when fresh water is involved.

For most people a mere dip in the sea water about midday is of infinitely greater value than the nerve-

exhausting, long morning swim, resulting as a rule in blue chattering lips and blanched finger-tips, and undertaken more as an act of bravado than in the fulfilment of any hygienic quest.

All serious bathing should be undertaken an hour before a meal, or about three hours after, and this applies to hot baths at home as well as to sea bathing.

In conclusion, I would like to suggest an explanation of the great value of bathing of all kinds which I have not before seen noted. It is well known that every group of muscles is supplied by the same nerve as the skin overlying it, and that this nerve has a local centre in a segment of the spinal cord or central nervous system. The beneficial influence produced is therefore in the nature of a reflex action, the stimulus to the skin passing rapidly to the spinal cord or brain, and then to the muscles.

Medicated baths have no specific general effect, but are often useful as local applications with a remedial influence upon certain skin diseases; but water baths of various kinds are often an excellent medium for the effective application of electricity.

Cleanliness has a special importance with regard to certain parts of the body, and is connected moreover with the treatment of their characteristic disorders.

The Secrets of Complexion.

The Face should be washed at least twice a day—cold water always being used. This acts as a tonic to the complexion, delays the approach of wrinkles, and is likewise refreshing and agreeable. Efficient washing and pure healthy blood are the only secrets of a good complexion. External applications which do not promote cleanliness are only so much obstruction to the efforts of the skin to look its best. This it can never do when unclean, even although flushed with the only basis of a

healthy colour (good, pure blood), in every capillary. Conversely, if the blood be wrong, no amount of cleanliness can be availing.

A good supply of blood ensures the presence of another important factor of a good complexion, namely, a sufficient layer of fat to produce plumpness, roundness of outline, and softness of skin. Lying underneath the skin of the whole body is a layer of semi-liquid fat, which fills in the depressions, allows the skin to glide smoothly over the underlying muscles and bones, and contributes much to its nutrition. When this fat is absorbed, as in starvation or illness, the skin becomes dry, rough, harsh, and fissured, and no amount of external application is capable of nourishing the parts, as the only method of feeding the skin is by feeding the whole body.

In addition to these three elements, and lying beneath the fatty layer, is the real substratum upon which the complexion is built, namely, the facial muscles, which give expression to the face by their constant contractions, and which, when wasted and thin, dispel the least possible chance of attractiveness in any countenance. Although they are voluntary, and therefore under the control of the will, they depend for their size and contour upon the sense organs, or rather the openings of these which they guard. Thus the muscles of the lower half of the face are controlled by and express the condition of the digestion, the muscles of the middle third are controlled by the condition of the lungs, and those of the upper part of the face respond to the impressions made upon the eyes, nose, and generally the whole mind.

We must eat well, therefore, if we are to keep unpleasant lines from appearing at the corners of our mouths, and live a wholesome, cheerful, open-air existence if we would keep crow's-feet away from our eyes.

Artificial Aids.

When all this has been said, however, this must still be added, that much, very much, can be done by art to delay the onset of the appearance of old age, although it is necessary to remember that the basis of all really cosmetic improvement of the complexion is the natural elasticity of the skin.

Hence strapping the face, which is distinctly useful as a means of removing excess of fat, is only of temporary value in the avoidance of wrinkles, and therefore best avoided.

Steaming the face relaxes the skin and soothes the muscles, melts the fatty contents of sebaceous glands, and opens the pores by stimulating the sweat glands. It is, therefore, a sovereign remedy for effective cleansing of the face, but owes its chief value to the fact that steam is absolutely pure water. Besides, it is necessary to use perfectly cold water thereafter, and even then it has left the skin worse instead of better, by reason of its removal of the natural oil.

For all practical purposes the following is the best method of improving the complexion. First make a paste of fine oatmeal and milk, and rub this all over the face with patient and thorough friction. Then with a soft rag wipe it off carefully and wash the face with lukewarm rain water, at the same time occasionally using a little superfatted soap. This will ensure perfect cleanliness of the skin, which is the first consideration. If the skin is rather greasy, two drops of lemon juice may be gently rubbed over the face, as this has a tendency to close the pores. Then dry with a soft towel. The use of soap which is too alkaline, or water which is too hot, removes Nature's face cream, and excessively vigorous friction has the same effect, the result being a chapped, coarse-looking skin. The least

scrap of almond oil or camphor ice—a mixture of white emollient ointment and camphor flowers—may now be rubbed into the skin, and, if there be any wrinkles, massage at right angles to the line of the wrinkle may be employed. Great care must be exercised in this, however, as in the wrong hands massage may do more harm than good, a knowledge of the direction of the circulation in the veins and lymphatics being requisite.

It should be remembered that the best skin tonic is cold, either in the form of air or water, because it compels a greater indulgence in exercise and food to keep up the temperature of the body.

The best skin food, again, is that which suits the digestion and assimilation best, and there is no specific diet which has a direct influence on the skin. There are some dietary articles which exercise a malignant effect, such as alcohol, strong spices and condiments, strong tea, and excess of meat. Milk and fish should be used in preference to meat by those with a coarse skin, and plenty of fruit and vegetables. Olive oil has been extolled in this connection, but only that quantity which is assimilated without risk is of any effective value, although at times the internal application of this bland oil is useful in the excessively thin.

To parody a well-known proverb, "Take care of the body, and the complexion will take care of itself."

A Few Prescriptions.

Applications of many varieties and of more or less value are made to the skin, and so long as too much is not expected of them, and the laws of health are simultaneously followed, no harm can result from their use. A beautiful skin should be smooth, soft, pliable, and of a dull gloss, its colour should be a dull white or yellowish brown, and it should be free from impurities,

such as anomalies of pigment, growths, anomalies of the sebaceous glands, and abnormal growth of hair.

The following is a useful lotion for use after exposure to sun or wind, or when there is chafing or roughness. It should be applied freely with a small sponge.

Distilled water, 5 oz.; powdered borax, 1 drm.; glycerine, ½ oz.; sulphite of soda, 2 drms.; rose water to 10 oz.

For the removal of sunburn, blackheads, and similar affections, this is valuable:—

Lanoline, 5 drms.; almond oil, 5 drms.; precipitated sulphur, 5 drms.; oxide of zinc, 2½ drms.; violet extrait, ½ drm.; tincture of alkanet, a sufficiency to impart a flesh colour.

The natural fats in this ointment are extremely useful when the skin is dry. When the skin is too moist, on the other hand, there is not the smallest objection to the use of a very fine powder, and this can be recommended as harmless and agreeable:—

Oxide of zinc, 4 oz.; orris powder, 10 drms.; French chalk, 5 oz.; essence of musk, 5 drops; jasmine extrait, ½ drm.; white rose extrait, ½ drm.; cassie extrait, ½ drm.

This powder should be applied with a puff after washing.

Cold Cream is simply an ointment containing an excess of water, which gives it a cooling effect during evaporation, and at the same time helps to extract excess of moisture from the skin. It should not be rubbed on, but simply smeared on the surface. Here is a simple formula for making it:—

White wax, 1 oz.; spermaceti, 2 oz.; almond oil, 6 oz.; rose water, 18 drms.; otto of roses, 8 drops.

It will be seen that it has a similar composition to camphor ice.

Glycerine is a risky substance to apply, as it has a great affinity for water and produces much smarting, because it draws too much moisture from the skin. It should therefore be used as a jelly, with some starch or isinglass and water, or well diluted with rose water.

Paints, varnishes, enamels, or stains are to be condemned except for theatrical purposes, and then only the very best quality should be used.

Freckles are produced by the action of the light rays upon the sebaceous secretion, the colouring matter of which is separated and stains the cuticle. They are either permanent or temporary, and it is only in these latter that remedies are of any value, and even then they should be applied without delay. The simplest and best application is buttermilk, and this owes its value to its contained lactic acid. Where it can not be obtained, the following may be kept ready for use:—

> Acid lactic (10 per cent.), 2 drms.; glycerine, ½ oz.; essence of white rose, 1½ drm.; tincture of benzoin, 1 drm.; water to 6 oz.

Black-heads and Acne.

Acne is the name of the disease which owes its origin to "blackheads." For many reasons, chief of which, however, is disregard of the laws of health, the sebaceous glands become overcharged or plugged with secretion, the part nearest the surface acquiring a coat of dirt, and so a comedo, or blackhead, is formed. This can easily be squeezed out by a watch-key, although the sharp edges are liable to damage the skin; or a comedo extractor can be purchased from the chemist, and the contents expelled, looking like, and commonly called, a "grub," or worm. When only a few are present, this is what should be

done, then the part should be washed with soap and hot water, and a little spirits of camphor painted on.

When, however, a great many are present, this is impossible, and as the contents quickly putrefy or decompose, inflammation is set up, and a red pimple originates, which is called an acne spot, and may proceed to suppurate. If this takes place, the contents are discharged, and, when the process of healing up is completed, a small scar, pit, or depression is left, which in many cases is so bad that an appearance is presented as if the victim had had an attack of small-pox. In these circumstances the most vigorous treatment is required for eradication.

Sometimes the most effective method is to sponge the skin with pure spirits of turpentine. If this is done pretty vigorously, and then the face well washed with hot water, the most hopeless case will at times acquire a beautiful complexion. This does not always happen, however, and then the only course open is to squeeze out each blackhead, steam the face over boiling water, thereafter wash it with a coarse woollen cloth, or scrub it with a brush even until it bleeds, and, after drying thoroughly, rub in a sulphur ointment. This is a good one:—

> Hypochlorite of sulphur, 1 drm.; simple ointment, 1 oz.

If this sets up too much irritation, it must be stopped for a day or two, and a soothing zinc ointment may be applied. Sometimes a lotion is more agreeable and effective, and this may be used:—

> Precipitated sulphur, 2 drms.; glycerine, 3 drms.; rectified spirit, 1 oz.; lime water, 3 oz.; rose water, 3 oz.

In addition to the above measures, internal treatment is often necessary, and then a medical man should be consulted.

A variety of face blemish which is of vital moment to many poor mortals is a red nose, and this in most instances is due to dilatation of the superficial blood vessels, and depends on some alimentary affection. The effective treatment of this condition requires not only appropriate internal medication, but very frequently the most careful scarification of the dilated vessels. The sharpest lancets and the finest of little punches is required for this purpose, and only an expert can use them. Good results are sometimes obtained without the necessity of resorting to these measures, by taking a dose of opening medicine each evening, and, after smearing the nose with oleate of bismuth ointment, to powder on the tip a small quantity of the following:— For Red Noses.

> Carbonate of bismuth, 4 drms.; oleate of zinc, 4 drms.; starch, 4 oz.

A simpler application still is a saturated solution of boric acid in water, painted on at bedtime, or this ointment:—

> Solution of the subacetate of lead, 4 drms.; lanoline, 2 oz.

Many cases, however, are quite incapable of improvement under external applications.

Moles may be treated by excision or electrolysis, whilst warts can often be exterminated by painting with glacial acetic acid three times a day. More powerful remedies are sometimes required, but should be left to the selection of the medical attendant.

Blushing, or morbid flushing of the face, is not necessarily an indication of lack of vigour or any diseased condition, but is an evidence of a badly balanced nervous system. Its intimate cause is closely associated with that portion of the nervous system—if such there be—where the will resides, and with inability to control The Cure of Blushing.

the filaments of the sympathetic nervous system which supply the blood vessels of the face. This results in their dilatation, and a feeling of warm suffusion which serves to increase the discomfort of self-consciousness. It is on a par with palpitation and other morbid phenomena of a reflex character, and shows that the sympathetic is not under the effective control of the central nervous system.

There is no specific which will cure this condition. The mind must be duly exercised and the will trained till the feeling of fear which is engendered by introspection is quite banished, much in the same way that drilling a recruit teaches him to respond to the word of command even when such obedience means facing the most fearful experiences.

When this is thoroughly understood, it is only a question of conquering the activity of the reflex by the constant practice of auto-suggestion. This is much aided by the suggestion of the medical attendant, and occasionally a little gentle sarcasm is not out of place. The sufferer may be reminded that he is not of such overwhelming importance that he need imagine himself the cynosure of every eye, and that indeed most people are too much taken up with their own affairs to trouble about him. Such reasoning has often a powerful influence for good, and enables a man to face situations which he would not otherwise attempt. This is highly important, because it is worse than useless to avoid occasions that give rise to the phenomena, just as the early ascetics found it useless to fly to the deserts to avoid temptations.

In most cases, indeed, it is wise for sufferers to take special opportunities of mingling with their fellows in gymnasia, physical culture, or dancing classes, and by

this means there may be acquired the power of displaying a less sensitive front to the external world.

The care of the hair is a large subject, which will be dealt with more fully when we talk of head coverings, in the chapter on "Protection." It will suffice here to say that if it be properly brushed daily with a nice soft brush, and washed, say once a week, with pure water and soap, nothing more is required to ensure its cleanliness or keep it in perfect condition. For this purpose special applications of all sorts and kinds are no more necessary than in the case of a horse, whose coat is kept in a condition of gloss by perfectly simple and mechanical means.

The Hands and Nails.

The hands should be washed at least before every meal. If this were attended to more regularly, many diseases would be avoided which are now quite common. This applies not only to lead poisoning and kindred maladies, but to others not so well known. If possible, running water should be used, but where this cannot be obtained, it is well to swill them out in a fresh basin full of clean water, before drying. In winter especially it is of supreme importance to dry them perfectly on a clean towel, as otherwise chilblains and chapped conditions very readily arise.

The nails should be washed with soap and water and a nail-brush, and the dirt which accumulates under them should be cleared out by means of a nail-cleaner. This dirt contains all sorts of microbes, hence nail biting and sucking is not free from the danger of swallowing harmful germs. Scraping the nails with a penknife is reprehensible, as it provides rough places for the lodgment of dirt. The skin overhanging the lunula or half-moon-shaped appearance at the root of the nail should be pressed back twice a week, or else it is apt to become torn and ragged, forming "hang nails," through which it

is quite possible for poisonous matter to enter the blood, and cause death. For this reason, although not absolutely necessary, it is a wise economy to invest in a cheap manicure set, which enables one to pay more careful attention to the condition of the nails. The finger nails should be cut in a curve, and special attention should be paid to the sides to prevent them growing into the flesh. The removal of white spots and stains from the nails will soon become unnecessary if proper attention is given to the "manicure."

Where the hands must be frequently washed, especially in the winter time or in an east wind, it is wise to rub them before drying with a little of the following lotion, which is also a sovereign remedy for the cure and prevention of chapped hands. Take 1 oz. of quince seeds. Roughly bruise them, and boil in 32 oz. of water until reduced to 16 oz. Strain through a flannel bag, gently squeezing the kernels, and add 8 oz. of glycerine and 8 oz. of bay-rhum. This is quite sufficient, but a little starch and boric acid often makes an improvement.

Sweating and greasy hands may be much improved by sponging them with a 2 per cent. solution of formalin in water, or using some of the dusting powders mentioned in connection with the feet.

Daily washing of the feet is an absolute necessity, but those who take a morning bath should pay special attention to the parts between the toes. The toe nails should be cut straight across, and it is even wise to cut a V-shaped part out of the centre of the free edge to discourage such growth as might bring about "ingrowing" toe nail. Further directions with regard to the care of the feet will be found in the chapter on "Protection."

The Formation of the Teeth.

It is quite impossible to exaggerate the importance of the most rigid and careful attention to the teeth, and this is only emphasised by the additional statement that such care ought to begin in the days of infancy. Nature has lavishly endowed us with two sets of teeth. The twenty milk teeth begin to be cut at the age of six months, and the process is usually completed by the end of the second year, although in rickety children, where teething often does not begin till they are a year old, the age of three may be attained before it terminates. These teeth begin to be replaced about the sixth year, and by the age of twelve or thirteen all the permanent set, except the last molars or "wisdom" teeth, are complete and ready for the process of mastication.

Each tooth consists of a portion above the gum, called the crown, a portion embedded in the gum, called the root or fang, and a narrow neck connecting the two. The outside of the tooth is very hard and white, and is called the enamel, and fits like a cap over the major portion of the body of the tooth, which is called the dentine, a substance like bone, full of fine long tubes. In the centre of the tooth is the pulp cavity, which goes right to the bottom of the root in the jawbone, and contains the blood vessels and nerves.

These thirty-two permanent teeth should be placed regularly in the sockets in the jawbones, and the upper and lower set should fit accurately upon each other. Sometimes, because of inherited peculiarities, they are too large in proportion to the size of the jaws, and so forced out of line, and crowded against each other; and the same defects arise by reason of mouth-breathing on account of adenoids in the naso-pharynx, or other cause, thumb-sucking, the use of comforters, and teats of feeding bottles. In these circumstances, or because of neglect

of the teeth in other ways, caries, which means decay in the enamel or dentine, arises, and toothache is set up.

The Toothache Bacillus.

Just what the specific causes of this condition may be is not yet settled, but it is certain that it is closely bound up with the development of microbes, of which no fewer than one hundred varieties have been found flourishing in the human mouth. As these cannot live upon a perfectly healthy tooth, they at first find a lodgment in fragments of food which are left sticking on, around, and between the teeth, and their vital activities result in the production of many toxins or poisons of an acid nature, which attack the enamel, and finally succeed in breaking down its magnificent resisting powers.

In addition to this, they often penetrate through little injuries in the gums themselves, and set up inflammation in the margins of the gums, causing these to recede from the teeth and expose unprotected parts of the dentine, which succumbs quicker than the enamel. Still further, they may make their residence in the delicate tissue of the gums, and finally undermine the foundations of the tooth in the socket, so that it quickly drops out even when fairly healthy.

Finally, the secretions of the mouth, acting on the soluble remains of the food, produce a material called tartar, which consists chiefly of lime with mucus and cells from the mouth, impregnated by a large number of bacilli, and forming a firm gelatinous mass adhering to the teeth.

The Use of the Tooth-Brush.

In all these ways decay of one kind or another is set up, and it will be seen how vitally important is the practice of cleanliness in the teeth and mouth. This should be started when the first milk tooth appears, and all that is necessary at this stage is to wipe out the mouth with a soft piece of rag dipped in a solution of

one teaspoonful of bicarbonate of soda or borax to a tumblerful of warm water. This should be done after each meal, and, in addition, night and morning, and as soon as possible the child should be taught the best method of using a tooth-brush.

Should caries arise in the milk teeth, it is of prime importance that a visit should be paid to the dentist at once, as decay in these teeth predisposes to decay in the permanent set. Not only lifelong indigestion, but such serious diseases as neurasthenia itself, may be set up by the highly poisonous discharges from these processes of decay.

For this reason, therefore, the use of the tooth-brush is absolutely indispensable, and the question of the best kind of utensil has given rise to much discussion. They are usually sold as soft, medium, and hard bristle brushes, as well as in other varieties, and it will probably be found that a soft or medium brush, with the bristles of unequal lengths, and not too closely placed together, will answer all requirements.

The method of using it is rather important, because, although friction in a horizontal direction is essential, still a vertical movement so as to get the bristles well in between the teeth will be found to be of much greater value. These two movements should be carried out not only on the outside but the inside of the teeth, and the space behind the last upper molar teeth must not be forgotten.

The brush may simply be dipped in water, or salt and water, but it is best to employ a good tooth powder of such a consistency as to produce a certain amount of polishing effect. The basis of most tooth powders is powdered chalk, or orris root, and some simple antiseptic like borax, tincture of myrrh, or carbolic acid, should be

mixed with it to destroy as many bacteria as possible. Precipitated chalk, which is obtained chiefly by the process of softening hard domestic waters, is better than prepared chalk, because it is crystalline and able to remove foreign matter without affecting the enamel injuriously.

A simple preparation is as follows:—

Camphor, 1 oz.; precipitated chalk, 9 oz.

Here is a sample of an antiseptic tooth powder, useful for smokers:—

Menthol, 3 grs.; thymol, 10 grs.; camphor, 10 grs.; salicylic acid, ½ drm.; powdered cuttle-fish, 2 drms.; powdered white soap; 2 drms.; precipitated chalk, 2 drms.; otto of roses, 4 drops.

Lotions, pastes, and soaps can also be used, and appeal to many.

In addition to the use of the brush, once a day at least, and preferably at bedtime, a piece of waxed dental floss should be passed between the teeth, so as to remove all foreign matter which the brush may have missed, although it is important not to use it too vigorously, in case the gums be cut or irritated. Then twice a week a piece of orange wood, charged with the tooth powder or some powdered pumice, should be rubbed over the surface of each tooth so as to remove any roughness or irregularity in the surface. Finally, the mouth should be rinsed with an antiseptic solution, and the simplest for this purpose is the old-fashioned tincture of myrrh and borax. This is a good recipe:—

Glycerine of borax, 1 oz.; tincture of krameria, ½ oz.; eau de Cologne, 4 oz.; tincture of myrrh, 15 oz.

A more modern and extremely useful mouth wash consists of equal parts of peroxide of hydrogen (10 vol. solution) and water.

The Indispensable Dentist.

If all these practices were taught at an early stage and carried out till late in life, not only would dentists have much less work to do, but even doctors might be driven to bewail their lack of employment. Nevertheless, regular visitations to the dentist at least twice a year, and if possible four times a year, should be a rule of life, and should be commenced even before the permanent set of teeth have begun to appear. Irregularities in the position of the teeth are then easily corrected, and overcrowding avoided, thus preventing deformities which are difficult to overcome at a later date. With such a practice, caries of the teeth may be altogether obviated, and a perfect set of teeth (a rare spectacle in modern life) obtained and preserved.

If, on the other hand, teeth have become so rotten that it is necessary to extract them, great and permanent damage is done to the opposing set of teeth, because those, especially in the upper jaw, begin to drop down for lack of opposition. In these circumstances, artificial teeth become a necessity, not only because mastication can be performed all the better with them, but to keep the proper shape of jaws, teeth, and mouth.

This is none the less reason for attending to the cleanliness not only of the remaining teeth, but also of the artificial plate, which should be taken out each night at bedtime, and allowed to soak in a glass of water with some harmless antiseptic overnight, being well brushed and replaced in the morning. Poisons from secretions of the mouth and decomposing food adhering to an artificial set of teeth are no less harmful than those on the ordinary teeth.

The student of this subject is sometimes tempted to ask whether, if the teeth were put to the use Nature intended for them, by selecting the proper kinds of food,

any artificial methods of cleansing them would be necessary at all. It has, however, been demonstrated that in all nations and in all climes, on all kinds of diet, caries is quite common. Vegetarianism, which by many is claimed as the only natural diet of man, has been shown to induce a worse condition of the teeth than mixed feeding, and so we are forced to the conclusion that although the food may be a prime factor in the health of the teeth, it is not everything. What is becoming abundantly apparent every day is that soft pulpy foods, which are too hot or too cold, or require no mastication, are bad not only for the teeth but for the digestion, and that those foods which demand the most mastication are most easily digested, and, as a further compensation, guarantee the most faultless teeth. Nature always paves the way for the removal of parts which are useless or not used. It is a wise policy to eat fruit at the close of each meal, as it cleanses the teeth from the remnants of starchy foods, which have a tendency to adhere to the surface of the enamel.

Acid fruits and drinks should never be used at bed-time, without subsequently brushing the teeth carefully to prevent inroads in the enamel.

The Functions of the Nose.

It would be impossible to exaggerate the importance of cleanliness in the nasal organ, both externally and internally. What has been said on the subject of the complexion will cover the ground so far as the value of the nose as an item of personal appearance is concerned, and what must now be said will deal with its function of preventing the entrance of the death-dealing dust into the stomach and lungs.

Whatever pleasure may be obtained from the nose as the organ of smell is frequently counterbalanced by its equal power of perceiving disagreeable odours, and this

capacity may be so pronounced as to obscure the chief function of the nose, which is undoubtedly its powerful filtering properties. Its anatomy, indeed, is chiefly directed toward this end, as it is divided into two cavities, lined with a freely secreting mucous membrane, each nostril being carefully guarded at its entrance by numerous hairs, called vibrissæ. Each cavity is divided by the shelf-like projection of the turbinate bodies on its outer wall into three chambers, the lower being specially concerned with breathing and the reception of tears, and the upper two with the sense of smell. These two regions of the nose are distinctly separated from one another, and it is always possible to tell, by examination under the microscope, from which region a piece of mucous membrane has been snipped.

The respiratory portion is covered by mucous membrane with a surface coating of ciliated epithelium somewhat similar to that on the bronchial tubes, and the air, as it passes in through the nose, is divided into two streams, the greater portion passing directly along the partition between the nostrils to the lungs, and only a small quantity passing up into the olfactory region. When air is breathed, as it ought to be, through the nose, it is altered in some important characteristics :—

(1) It becomes warmer.

(2) It is moistened with watery vapour almost to the point of saturation.

(3) It is freed from its particles and germs, not only because they are entangled with the hairs, but because they are detained by the moist mucous membrane, and where this membrane is healthy and the mucus in good quantity and quality, the germs are practically killed on the spot.

The tongue is the organ of taste, but the appreciation of flavour demands the co-operation of the sense of smell in addition, and this explains why it is impossible to taste one's food properly when one has a cold in the head.

The sense of smell is so acute that it is possible to perceive musk to the amount of the two-millionth part of a milligramme, which of itself is an infinitesimal quantity, and it is easy to detect one part of sulphuretted hydrogen in a million parts of air. But other substances, such as ambergris and mercaptan, may be detected in still smaller quantities. It is rather difficult to say just how the sense of smell is stimulated, but we know that it is possible to appreciate non-pathogenic bacteria, whilst the disease-producing or pathogenic bacteria cannot be smelled.

Many different kinds of pathogenic bacteria have been discovered in the nose, and, if not killed by the mucus, may penetrate into the tissues or be swallowed, and thus set up disease, *e.g.* diphtheria, measles, cholera, typhoid fever, etc. They and they alone are responsible for inciting the disease, hence it is erroneous to talk of catching diphtheria by inhaling a bad odour, as the smell itself is incapable of setting up the disease.

Hand-kerchief Reform.

Excess of mucus and tears must either be swallowed or trickle out of the nostrils, and man possesses the doubtful honour of being the only animal who uses a handkerchief, which of all the articles introduced by civilisation is the most filthy. How much disease is spread by this little square of silk, cotton, or linen, it would be impossible to estimate, and the special pockets and receptacles retained for stowing away the handkerchief must be saturated with disease-producing matter beyond measure.

The use of Japanese paper handkerchiefs for ordinary

purposes is no less demanded by the laws of health than by the dictates of refinement. But who will be the courageous pioneer to start it?

The Evils of Mouth Breathing.

To be a health-producing and not a disease-provoking organ, the nasal passages must be kept quite free—a condition that is rarely complied with. In a child the chief cause of obstruction is to be found in the upper part of the throat or pharynx communicating with the posterior nasal cavities, and is due to an exaggeration of the pharyngeal or third tonsil, adenoid growth being the result. This is productive of mouth breathing, with all its disadvantages, and, if not rectified by operation or otherwise, leads to the production of deformity, with some or all of the following characteristics—a small nose, a narrow upper jaw with protruding front teeth, a stupid expression, and, worst of all, a faulty expansion of the chest wall, producing pigeon breast.

From what we have already said regarding mouth breathing, it will be seen that, when respiration takes place through the mouth, the valuable features imparted to the air are lost, namely, the warmth and moisture; the irritants extracted from the air also are retained. Hence cold, dry, dusty, germ-laden air is impinged right on the back of the throat, and not only sets up inflammations of manifold kinds, but likewise is directly responsible for the reception of infectious disease. Not the least of its disadvantages is that it is contributory to the still further contraction of the nasal cavity, by reason of thickening of the mucous membrane, growth of polypi, and other well-known effects.

No more certain means exists for the production of a cold in the head than this very mouth breathing, and this again is apt to set up additional catarrh, so that even in a nose devoid of any serious pathological defects

which can be remedied by operation, there is much need for some simple subsidiary means to prevent all the dangerous consequences of nasal catarrh. This subject will be dealt with more fully in the next chapter on "Protection," but, as it is a very powerful contributory factor to the production of disease, some means other than the simple propulsion of mucus into a handkerchief may easily be adopted with the greatest benefit to health.

For this reason, in large cities, or where one is unusually exposed to the inhalations of excessive quantities of dust, the more or less regular cleansing of the nose by a simple alkaline saline solution is of great advantage. This is easily made by mixing together one ounce each of borax, bicarbonate of soda, and common salt, and dissolving a saltspoonful of this powder in a third of a tumbler full of lukewarm water. Then, by slightly tilting up the tumbler, the solution can be easily sniffed through the nose and brought out by the mouth. The nose should now be blown very gently, and occasionally the following ointment should be painted into the nostrils, taking care that the brush is pushed backwards in the direction of the lower lobe of the ear:—

Menthol, tannic acid, of each 5 grs.; eucalyptus oil, ½ drm.; vaseline, 1 oz.

This is not only strongly antiseptic and astringent where the mucous membrane is too thick, but is likewise useful in the prevention of crust formation—a prolific cause of disease, leading to constant picking of the nose, and the production of boils and more serious evils still, on account of the raw surface favourable to absorption which is thereby left.

The Eyes.

The hygiene of the eyes and ears has been treated exhaustively in the chapter on "Rest," but to complete

the picture of cleanliness it will be requisite to deal briefly with each of these departments here.

Little need be said in connection with the cleanliness of the eyes under normal conditions, because nothing further is required than the use of the same means as were mentioned when writing of face washing. But one is constantly being asked how to make the eyes stronger, whether hot or cold water should be used for this purpose, and what is the best lotion for strengthening them.

These questions usually proceed from people who have some little irritation of the eyelids or conjunctiva, *i.e.* the thin transparent mucous membrane which lines the front of the eyeballs and is reflected on the inner surface of the eyelids. This trouble is quite as frequently caused by some error of refraction in the eyes, producing strain in their use, as from exposure to such irritants as cold winds or dust of varied kinds.

When the eyes are perfectly healthy there is not the slightest necessity for using any eye lotion, or for opening them under water either hot or cold. Indeed, this latter expedient is quite as likely to set up inflammation as not, just as exposure to cold winds and draughts of one kind or another is apt to bring about irritation in highly susceptible people. In this latter case the irritation may be due to the impinging on the delicate conjunctiva of minute particles of dust, which cannot be dealt with by the ordinary processes of lachrymation and winking. Sufferers from this cause should keep a simple eye lotion of an antiseptic and astringent character on the dressing table and use it frequently. Probably the best is composed of 1 drm. of boric acid dissolved in 6 oz. of boiled water and allowed to cool. A few drops of this, sucked up by an eye

20

dropper—of which there are now many forms on the market—can be squirted into the eyes two or three times a day, the head being held well back and the eyelids separated by the forefinger and thumb of the left hand, the right being used for instilling the drops. Before closing the eyelids the eyeballs should be rotated slowly until the solution finds its way into every corner of the eye.

Where such simple means do not suffice to keep the eyes perfectly comfortable, then an oculist, *i.e.* a medical man practising eye diseases as a speciality, should be consulted with a view to discovering the real cause and prescribing spectacles if necessary. In conclusion, it may be added that it is a very refreshing practice to bathe the eyes first thing in the morning and last thing at night, and at the same time to massage the eyeball gently through the closed eyelids.

The Ear. Although there is a much greater tendency to the accumulation of foreign matter in the ear than in the eye, still it could be kept clean quite as effectively by Nature's methods if we only left her alone and ceased to irritate her with our blundering and meddlesome interference.

The external ear consists of the projecting auricle popularly called the ear, and the depressed canal called the external auditory meatus, which penetrates for a little more than an inch inwards in a curved direction. At its inner end is the drumhead or membrana tympani, and its walls are lined with a modified form of skin, supplied at the outer part with hairs and glands, similar to the sweat glands of the skin. It is very narrow and much curved, and this, along with the hairs and the wax-covered walls, serves to keep out most foreign bodies from the delicate structures within.

The cerumen or ear-wax is a thin yellowish fluid formed by the glands aforesaid, which immediately upon secretion begins to thicken by evaporation and mixing with the epidermal scales. The yellowish paste thus formed is slowly propelled to the outside by the little hairs and by the movement of the jaw in eating, and, unless by misguided efforts at removal, is not in the least likely to reach as far as the drum, as the inner third of the canal does not secrete wax and the drum itself is provided with a vital mechanism for pushing its own epidermal scales to the outside.

In any case, wax is unlikely to accumulate in a perfectly healthy ear, but where for any reason there is excessive secretion of cerumen or an inordinate amount of dust is allowed to penetrate the canal, accumulations of wax are liable to take place. This may go on for a long time without the patient becoming aware of it, and without even losing any acuteness of hearing. When, however, the canal is quite blocked, deafness results, and this may happen quite suddenly if water be allowed to penetrate into the ear, because it rapidly swells up the ceruminous mass, bringing a sudden deafness and frequently pain from pressure on the drum, as well as a feeling of fulness in the head, ringing of the ears and giddiness. If only a small quantity of water has obtained entrance, the mass may soon become shrunken again, and the above symptoms disappear—to reappear when more moisture or even damp air during wet weather gains admission.

In simple cases effectual syringing of the ear will soon remove the mass and restore comfort. Where the plug is very hard and firmly impacted its removal should not be immediately attempted, and it is much wiser to instruct the patient to instil into the ear three

times a day for three days a few drops of glycerine of borax, heated by pouring them into a warm spoon. A little bicarbonate of soda and glycerine, in lukewarm water, acts in the same way. But it is unwise to employ oil of any kind. The water for syringing should be about 110° F., and fairly vigorous efforts are required to expel the wax, but it is necessary to guard against too forcible measures in case inflammation be set up. Sometimes even fainting accompanies the little operation, and the process should be immediately stopped and the patient laid flat on the back for a short time.

Where these simple measures are not successful in removing the wax, a medical man should be at once consulted, who will probably succeed by more effective instruments.

At no time should any sharp or blunt instrument be inserted into the ear by other than a medical man, as such a practice is not only most reprehensible, but attended with considerable danger. But where a small accumulation of soft wax is very close to the external orifice, there is no harm in a large-headed pin, well covered with cotton wool or wrapped deftly in a pocket handkerchief, being gently used as a lever for its extraction. After syringing, a little piece of cotton wool may be inserted for a few hours, but otherwise the use of cotton wool is deleterious, interfering with the proper exit of the wax, and, being frequently forgotten, it is apt to become the basis of a collection of wax.

Practical Summary.

1. Daily cleansing is necessary, because we live in an atmosphere of dust, which coats our skin and fills our eyes, nose, and scalp, thus obstructing their functions.

2. Friction with a good pair of horse-hair gloves is an excellent preliminary to bathing.

3. A morning bath is an absolute necessity, but should rarely be practised in cold water, which is not sufficiently cleansing.

4. Reaction is deceptive, and our feelings just after the bath are not the real test.

5. Perfect cleanliness of the skin can only be obtained by the use of warm or lukewarm water, plenty of soap and a loofah or scrubbing brush. This may be followed by a cold shower or a rapid cold sponge-down.

6. Soap should be superfatted and free from excess of alkali.

7. Turkish baths are valuable on occasion, but only when special precautions are taken.

8. A hot reclining bath should be taken once or twice a week.

9. Sea bathing is valuable, but grave risks attend it when too prolonged,

10. In a city the face should be washed at least twice a day.

11. Cleanliness, pure healthy blood, good food, and exercise in the open air are the secrets of a good complexion.

12. The best "skin foods" are taken internally, not applied externally.

13. Lotions for freckles, sunburn, etc., and cold cream serve useful purposes.

14. Acne is chiefly due to careless washing.

15. Red nose may be caused by indigestion in some form, probably aggravated by nasal catarrh.

16. Blushing is an evidence of a badly balanced nervous system, and is not necessarily an indication of lack of vigour.

17. The hair requires careful daily combing and brushing and a weekly wash.

18. The hands should be washed at least before every meal.

19. The feet must be washed each day by those who do not take a morning bath.

20. The teeth must be brushed each evening before bedtime, using a good tooth powder, and in addition first thing in the morning without the powder. It is probably a counsel of perfection, but nevertheless hygienic, likewise to brush them after each meal. The occasional use of silk dental floss is valuable for effective cleansing between the teeth.

21. The nose should be washed out once a week or oftener by a warm saline alkaline solution which keeps the nasal passages free and the mucous membrane healthy.

22. The eyes require little attention for cleansing purposes other than that given in the daily washing of the face, but when much used are improved by a morning and evening douche.

23. The ears should not be cleansed from wax by picking with pins, but where simple safe measures are unavailing should be syringed with lukewarm water.

CHAPTER IX.

PROTECTION.

LAW VIII.—"For purposes of protection clothing should be worn which is neither too heavy nor too light."

MAN is a homoiothermal or "warm-blooded" animal, *i.e.* one with a constant temperature, in contra-distinction to a "cold-blooded" animal, whose temperature varies with its surroundings. In these degenerate days he maintains his temperature at a constant rate solely by means of wearing clothes, which enable him to keep next his skin a warm layer of air about 90° F., whereas without clothes, even although the external temperature should be as high as 80° F., he would be quite unable to keep the heat of his blood at the normal level.

"Warm-blooded" and "Cold-blooded."

It will be necessary, therefore, to consider the whole problem of the manufacture and dissipation of heat, in order fully to appreciate the value, nay the necessity, of clothes.

Note in passing that heat is a by-product and not a special manufacture, a by-product of those life processes carried on within the cells and collectively designated "metabolism." Certain physical and chemical changes take place in those minute particles of proto-

plasm, causing them to assimilate the material by which they are surrounded and work it up into their own constitution, making it indeed a part of themselves. It is then still further changed by elaborate and recondite processes not yet fully understood, whereby its complex constituents are broken down into simpler elements, some of which are thrown off into the blood.

This building-up or "anabolic" and breaking-down or "katabolic" process goes on as long as life lasts. In fact, life is the resultant of the whole series of changes, a vital phenomenon so-called, but clearly dependent on physical changes. (See Chapter IV., p. 113).

Now, chemical union sets free heat, and chemical decomposition renders it latent or causes it to be absorbed, and the nett result is that much more heat is produced than is required to maintain the body temperature at the usual level. Indeed, if it were not constantly being lost it is calculated that a 10-stone man would reach the boiling-point in thirty-five hours.

The more "vitality" a man possesses, the more heat his body produces, and anything which interferes with the vital activity of his tissues, such as the use of narcotic drugs, causes a lessened heat production. It is in this way that alcohol lowers a man's temperature instead of raising it, as common ignorance supposes—a fact which attaches great risk to the practice of thrusting an inebriated person into a cold cell. There is great danger in such a case of finding that death has occurred during the night, owing to the lessened heat production and the increased heat loss.

A Misnomer. No life can exist without the production of heat, and hence there is, strictly speaking, no such thing as a "cold-blooded" animal, that term being used to indicate one whose temperature varies with its surroundings and

which is therefore limited in its movements. The great advantage of a constant temperature lies in the fact that its possessor is more or less independent of climate, and can travel to and fro on the face of the earth to suit his inclinations and convenience. To ensure this constancy, a mechanism for the regulation of the temperature is necessary, and exists in all the higher animals. Before it is fully developed, as *e.g.* in children prematurely born, and to a lesser extent in newly born children, artificial warmth must be applied to keep the fires of life burning.

It is interesting to note that, although the temperature of the higher animals is what is called "constant," in no species or individual does it maintain an absolutely fixed level. For man it may be set down as 98°·6 F., although anything between 97° F. and 100° F. may be looked upon as normal, whilst for mammals it is 102° F., and for birds 107° F. No adequate explanation of this difference has yet been advanced.

Although the temperature in man is fairly uniform at 98°·6 F., it varies from hour to hour, attaining its maximum at 5 p.m. and its minimum about 2 a.m., the time when the greatest number of deaths occurs. Strange to say, these hours are reversed when a man is compelled to earn his living in a nocturnal employment; and in the same way, when day is turned into night by journeying to the antipodes, the rhythm adjusts itself to the new conditions, these facts going to prove that the variation is due to fluctuations in the metabolism of the individual.

The Manufacture of Heat.

The manufacture of the heat takes place during and because of the working of the muscles and glands, and the heat is given up to the blood, by means of which it is carried to the rest of the body. It is not therefore

increased heat production, but effective heat distribution, that gives us the nice comfortable glow during and after exercise, the bodily tissues themselves being indeed bad conductors and only responding to the warm blood pumped into them. For purposes of heat-distribution there could be no finer medium than the blood, which finds its way into the furthermost recesses of the body, so that it is impossible even to prick the surface without causing some to escape.

The blood is really a fluid medium for carrying oxygen and nutriment to the tissues and bearing waste matters away from them, and this is effected by means of blood vessels, a system of tubes running all through the body. Blood is an opaque sticky fluid, consisting of a fluid portion, straw-coloured and transparent, called "plasma" (containing saline, saccharine, and fatty constituents), and a more solid portion made up of red and white corpuscles.

The red corpuscles are biconcave discs, $\frac{1}{3200}$ of an inch in diameter, having embedded in them a substance called hæmoglobin which has an extraordinary affinity for the oxygen in the air. These red corpuscles are the means whereby the oxygen is conveyed to the body tissues.

The white corpuscles are a little larger than the red ones, globular in shape, and much fewer in number, and they contain one or two nuclei. They have the power of changing their shape and penetrating the walls of the blood vessels, so that they can the more effectively carry on their function of scavengers for the body. Metchnikoff christened them "phagocytes," because they eat up the microbes, dirt, and other foreign matter gaining access to the body, and deposit it safely in the lymphatic glands, there to be elaborated into harmless substances.

Blood remains fluid so long as it is within the blood vessels, but clots whenever it is extruded from them, and if allowed to remain still in a vessel for twenty-four hours it forms a dense firm clot, surrounded by a straw-coloured fluid called the serum. The clot consists of the albumin with the corpuscles entangled in its meshes, and the serum consists of all the other fluid portion. It is in virtue of this remarkable property of clotting that cessation of hæmorrhage takes place, and it is much encouraged by the bleeding parts being kept at rest, freely exposed to the air and subjected to pressure by some foreign body. Blood is capable of being rendered impure by eating the wrong kinds of food, *e.g.* too much meat and excess of purins, by inhaling foul air, and by taking little or no exercise and thus preventing the excretion of the waste matter contained in it.

The Pump of the System.

The system of closed tubes containing the blood is provided with a pump, called the heart, which by means of its contractions keeps up the circulation through the arteries, capillaries, and veins. The heart is a hollow muscle consisting of four cavities, two of which (for collecting the blood) are called auricles, and two (for propelling the blood into the body) called ventricles. The right auricle collects the venous blood from the body and pumps it into the right ventricle, whence it is propelled into the lungs. Here it is subjected to the action of the oxygen in the air, which becomes intimately associated with the hæmoglobin of the red blood corpuscles, and at the same time loses its carbonic acid and thus becomes arterial blood, flowing into the left auricle. Thence it makes its way into the left ventricle, whence it is pumped right through the arteries and so into the capillaries and tissues of the body. It will

thus be seen how this simple mechanism of the circulation conveys the heat to every part of the body, and, whilst maintaining the temperature at a constant rate, is the chief means whereby the heat is distributed and lost.

The temperature of the body maintains its unvarying rate :—

(1) By increasing or diminishing the production of heat.

(2) By increasing or diminishing the loss of heat.

(1) Varying the Production of Heat.

During the state of repose quite 75 per cent. of the body's heat is produced by the muscles, while in a condition of activity this proportion is raised to 90 per cent. It is important to remember that 40 per cent. of the body's weight is composed of muscle, 5 per cent. of blood, and 2 per cent. of brain. The use of the muscles in exercise causes the temperature to rise quickly above normal, but it drops in a very few minutes to its accustomed level. The arm-flapping and foot-stamping which one so constantly sees practised by those exposed to cold are methods of voluntary exercise of the muscular system executed to raise the temperature, whereas shivering is an example of involuntary or semi-involuntary muscular exercise to serve the same end. Such heat when produced is quickly conveyed by the blood to every part of the body in a normal person; but when the movement of the blood is languid and the superficial vessels are contracted either by cold or under the influence of a supersensitive nervous system, it is not well distributed, and in that case difficulty is found in keeping warm.

Cold as a rule acts as a bracing agency or tonic to a healthy man, causing a greater manufacture of heat in the

muscles and glands; but in some people who are said to have a "bad circulation," and in all when the cold is excessive, it has the effect of paralysing the heat-regulating mechanism in the same manner as large doses of alcohol. Such people may have perfectly strong hearts and efficient blood vessels, but they belong to the class usually categorised as nervous, and the small arteries, especially of the extremities, are liable to a sudden contraction under a very slight stimulus, thus actually cutting off the blood supply, with its life-giving heat, from the tissues. Hence their complaint of "dead" or "numb" fingers, cold feet and hands, cold ears, chilblains, etc. They frequently also complain of blushing and palpitation, which are due to much the same cause, and are embellished with red noses and pale faces.

What most of them require in order to reinforce the production of heat is a series of good square meals with plenty of leisure to eat and digest them. Every one knows the stimulating effect of a good warm meal, which supplies pabulum not only to nourish the tissues, but also to warm the blood and increase its heat-giving and circulating power. Of the three important constituents of the food, proteins are first in their power of generating heat; and if we classify that potency as twenty, then that of carbohydrates is ten and that of fat seven.

(2) Varying the Loss of Heat.

Of the total amount of heat lost by the body, the skin is responsible for 87·5 per cent., the lungs for 10·7 per cent., and the excreta for 1·8 per cent. The skin is the only channel which we can easily control in its loss of heat, and that is the medium utilised for regulating the temperature in man.

Seventy-three per cent. of the total loss from the skin is accounted for by radiation—the simple emission or diffusion of rays of heat, and this is, of course, greater

in cold and dry air. Small people lose heat much more rapidly by this means than large people, because they have a greater superficial area in proportion to their size.

Conduction is another method whereby heat is lost from the skin, and as water is twenty-eight times a better conductor of heat than air, much more heat will be lost from this cause on a damp day than on a dry day. A good layer of fat on the outside of the body helps to preserve its heat, as fat is the worst conductor in the body. When the air is in motion, as on a cold, damp, windy day, a great amount of heat is lost, as successive layers of cold air impinge on the warm atmospheric layer around the skin and thus rapidly cool it. The same occurs in suffering from an ordinary draught.

When we realise that the superficial area of all the tiny sweat orifices of the body is equal to 10,000 square feet, or that, when placed end to end, there are close upon 30 miles of sweat glands, we cannot be surprised to know that from 30 to 50 oz. of sweat are lost by evaporation in a day. During exertion, however, this may be greatly increased, and an athlete has lost as much as 8 lb. in a seven-hours' tennis match on a hot day. It is chiefly in short, stout people that evaporation of sweat is brought into play.

The Function of Clothes.

The chief function of clothing is to diminish this great loss of heat by the skin, but the fact that the natives of such an inhospitable climate as Tierra Del Fuego in the present day, and our own ancestors in days gone by, can and did respectively exist without any clothing at all, unless for purposes of adornment, is sufficient proof that it is not absolutely essential. But as civilisation progresses, men live more by their wits than by the exercise of their muscles; they do not possess the vigorous con-

stitutions of their forbears, and they cannot afford to expend their nervous energy only in the direction of manufacturing heat.

Clothes should lessen the loss of heat by radiation and conduction, and interfere as little as possible with evaporation from the skin, so as to render the weather warm in winter and cool in summer, without hampering the action of the skin. For this reason they should at all times be as light as possible, and, whatever material be selected, two important considerations must be carefully attended to: (1) Clothing must be a bad heat conductor; (2) it must be a capable absorbing agent.

The Value of Loose Garments.

(1) It is hardly necessary to state that clothes are not of themselves warm, but simply prevent the loss of heat by reason of being bad conductors. An investigation into the heat-conducting properties of materials utilised for clothing purposes demonstrated that silk is the quickest and fur the slowest conductor; while linen, cotton wool, sheep's wool and eider down are slower conductors than silk in the order in which they are mentioned. One of the slowest conductors of heat is air, and Nature has taken advantage of this fact in her fabrication of wool, fur, and feather.

Air is of the very greatest value in retaining the heat of the body, and should be utilised not only in the layer of warm air for which provision is made between the skin and the garment worn next to it, but also, if possible, in the structure of the fabric itself. Where this warm layer of air is awanting, combustion is much greater and cooling much quicker, and for this reason tight garments are less warm than loose ones. The wearing of two thin garments will engender a greater warmth than one thick garment, even although their combined weight is less.

Underclothing should always be woven loosely, so as to contain as much air as possible, and this "cellular" plan can be applied either to wool, linen, or cotton. A thousand volumes of soft flannel can contain 923 volumes of air as against linen, which can only contain 723.

The Importance of Wool.

(2) When we realise that the sweat glands give off about 50 oz. of water daily in the form of vapour and a small quantity of carbonic acid, with fat and other matters, we require no more cogent reason for insisting that clothes should have absorbent capacity.

In this respect wool occupies a pre-eminent position, as it can absorb much more water than linen, cotton, silk, without feeling wet. Then, again, when it is thoroughly wet only 26 per cent. of its air-containing surface is closed up, with the air displaced, as compared with 39 in silk and 56 in linen. It is also more difficult to wet, because of the natural oil it contains and the horny covering of its fibres. Again, the evaporation of moisture proceeds much more slowly from woollen clothing than from silk, linen, or cotton, and so a saying has arisen that, no matter how cold and wet it is, it is always warm and dry. So much has been written and said in favour of cellular underclothing made of cotton and linen that it has become quite the fashion to decry the use of wool in the manufacture of such garments, but the above facts prove that wool still retains pride of place as a material for underclothing, and does not hold its reputation without warrant.

There are some current objections to its use which may just be mentioned. (1) Expense. Even although this has rather advanced in recent years, in common with the price of most articles, too much has been made of it, because, with care, goods fabricated of wool, can

be made to last longer than cotton or linen, whilst silk is quite out of the running.

(2) Irritation of the skin. It is an unquestionable fact that just at first some people find it produces intense itching, but not only is this a purely passing phenomenon, as the skin soon gets accustomed to it, but the wool itself becomes less capable of irritating every day it is worn. In any case, the objection may be entirely obviated by wearing a net of silk or other material next the skin, without losing any of the unquestionable advantages of the wool.

(3) When washed it is apt to thicken and "felt." This is also quite true, but only when great neglect is displayed in the washing. In this process soap should never be used, but ammonia; nor should great violence be exercised in the manipulations in the wash-tub. In addition a drying frame should be purchased and the clothing spread over this whilst drying, which will prevent any chance of shrinking.

(4) It absorbs, and consequently emits, odours. This is also true to a certain extent, but is only markedly noticeable when for any reason excessive perspirations take place and washing has been postponed too long.

Prominent among those who oppose the use of wool as a material for underclothing is Dr. Leonard Williams, who contends that its capacity for absorption is much inferior to cotton or linen. He relies upon the fact that a piece of flannel placed on water will float because it refuses to absorb this fluid for many hours, whereas a piece of linen, cotton, or silk will sink almost immediately. He suggests that the incredulous should use a flannel handkerchief during their next cold in the head to convince them of the indifferent absorbing qualities of wool. There is an apparent contradiction

21

between these facts and those already mentioned in favour of wool underclothing, but I think they may easily be reconciled if it be remembered that the underclothing is rarely asked to absorb water except in the condition of vapour.

The Fallacy of Hardening.

There should be at least two layers of clothing—what is usually designated underclothing—and the ordinary outer garments, and, as constitutions differ markedly, it is wise for each to study himself in the disposition of these. Having seen the principles underlying correct clothing, it should be obvious that there is no specific date on which one should don summer or winter garments, but this date should depend entirely on the temperature of the external air, the amount of humidity contained therein, and other factors which will easily occur to the intelligent mind. At least three different thicknesses of underclothing should be in the wardrobe for summer and winter and intermediate seasons respectively. The weight of the necessary clothing should be from six to twelve pounds, depending upon the season and habits, and this can easily be doubled by adding an overcoat. Animals are much better off in this respect than human beings as, *e.g.*, a dog of nine pounds weight has only three ounces weight of hair.

It is a very great mistake to attempt to brave the weather without clothing appropriate to the season, a practice which arises from the exploded theory of "hardening." One need not wait to catch a chill before changing the clothes The practice of wearing thin underclothing all the year round and donning no overcoat is most reprehensible and dangerous. Even a man with a very vigorous constitution runs risks in such circumstances, and must be possessed of a powerful digestion to cope with the extra supply of food required. Even in summer

and in tropical climates it is safer for most people to wear wool next the skin, especially in damp neighbourhoods. Silk, cotton, and linen are very useful, but it is safer to wear thin wool and a thinner make of outer garment.

The colour of our external clothing is a matter of some importance. If a piece of light cloth and another of dark cloth be placed upon snow it will be found that the snow melts quicker under the dark cloth, showing that it absorbs heat better. Hence white or (khaki) yellow is more suitable wear for hot weather or tropical climes.

Underclothing should be changed about once a week, and the same clothing should not be worn night and day, but be carefully hung up on the back of a chair during the night-time to air.

The clothing of infants surely requires some modification in this enlightened age. Too long have the poor mites been groaning under their superincumbent mass of meaningless garments, inflicted upon them by thoughtless women who ought to know that weight and tightness of clothes at this age are a handicap on growth as well as on activity. It is not as if any attempt had been made to exhaust the possibilities of hygienic science in an effort to clothe the newly born suitably, because the array of Lilliputian garments employed is simply an imitation of the garments worn by older people, and it can hardly be beyond the wit of man or woman to devise something more suitable and healthy. Infants.

All that is absolutely necessary is

(1) Some substitute for the hopelessly tight binder so often wound round and round the little abdomen upon the plea that it is essential to prevent an umbilical rupture. Such can be found at any surgical instrument

maker's shop, or can be manufactured out of one or at most two layers of a roller bandage.

(2) An under-garment composed of soft absorbent material, covering the child from neck to ankle and wrist, and fastened down the back.

(3) An upper garment of some thicker non-conducting material for purposes of warmth.

Children and "Growing Pains."

The clothing of children who have passed the stage of infancy is about as hopelessly antiquated as that of their juniors, and the garments are constructed apparently with a greater desire to gratify their parents' pride and sense of ownership than to satisfy the demands of health. What is actually required is some sensible loose non-conducting and absorbent garment sufficiently warm to protect the child from the rigours of the weather. Instead of this we are apt to find what might be styled lack of clothing, exemplified by an abbreviated upper garment, a long length of bare leg, and a pair of short stumpy white socks. Such barbarous fashions are very insufficiently excused by conceptions of superficial prettiness, nor is the case improved by invoking those obsolete ideas of "hardening" which have ushered so many innocent little children into an early grave, or a life-time of injured health. These little folks sustain a greater loss of heat from their proportionately large superficial area, and every scrap of energy lost in this way must be made up for by extra food, thus taxing the organs of digestion and excretion beyond their limits of endurance.

A committee of experts in Berlin, after a ten years' practical inquiry into the results of "hardening" young children, proved decisively that a greater percentage of the "hardened" died than of the unhardened, and that the former were infinitely more liable to disease in after

life. Nothing, perhaps, will avail to stop the frightful holocaust of young lives until a striking example is set in some exalted quarter, and then we may expect to hear no more of the so-called "growing" pains, practically all of which are due to rheumatism induced by insufficient protection for the limbs of growing children.

It is hardly necessary to enter into details of all the unsuitable forms of garment worn at this time of life, including the kilt and sailor suit, and others no more suitable. Enough has been said to emphasise the necessity for attending to the principles of clothing already laid down, and special care should be taken to see that the lungs (at their back parts particularly), the loins, and the limbs are all carefully protected from exposure to cold or a too rapid loss of heat.

Young girls are, as a rule, much more sensibly clad than their mothers, because warmth with moderate weight, more or less equally distributed over their bodies, is usually the keynote of their clothing.

Women and the Corset.

The most vulnerable part of a woman's clothing is the long heavy bedraggled skirt suspended from the middle of the body, and this at once brings us to the consideration of the point as to whether the corset is at all admissible as an article of attire.

I have given long and careful consideration to this question, and I frankly confess I have not yet become a convert to the views of the Hygienic Dress League. I admit at once that the enormity worn by a large proportion of the women of this and other civilised countries, which distorts their figures, and compresses their livers, stomachs, and other abdominal organs, is a contrivance admirably calculated to produce disease and so to cripple and confine a woman's energies. So long as these malpractices are continued, woman must of necessity remain

the weaker sex. I should be sorry to think that the ordinary sensible woman of the present day has any hankerings after such an instrument of torture, and does not rather select an article with most of the good points and as few as possible of the bad points of the corset. I cannot subscribe to the doctrine that woman should suspend her clothing—at any rate, the clothing she is compelled to wear at present by custom and law—from her shoulders, and I cannot help comparing the physique of the young man and woman of the present day with special reference to their erect gait, greatly to the advantage of the latter.

It is not only that housework is more apt to create better figures than desk work, because female clerks are quite as erect as their housewife sisters; it is the fact that the corset not only acts as a brace to the spinal column, but takes the weight away from the sloping shoulder where it has a tendency to contract the chest and cause a decided stoop, and transfers it to the crest of the "ilium," which is by all anatomists held to be the most powerful bone of the body.

Where, however, the deforming corset I have condemned is worn, the weight of the skirt is removed a little higher up to the wasp-like waist, and along with the corset helps to compress the abdomen and bear down upon the delicate organs contained therein. Such a corset makes the skirt heavier, because it removes the suspending line from the crests of the ilium to a higher point, and hence a longer skirt is necessary, and indeed this is a point specially aimed at.

Where a sensible corset, with or without some strengthening material like whalebone or other elastic support, is worn, I cannot but think that it will be found of great value as a protecting medium, and may

be used as a means of more equally distributing the weight of the clothing than if the latter were entirely suspended from the shoulders. With such an arrangement garters may be dispensed with, and just how many generations of women have suffered from varicose veins due to this cause it would be hard to say. Besides, where a woman wears an all-wool combination undergarment, a sensible corset, a warm pair of tweed or woollen knickers, and a warm blouse, there is only the necessity for suspending the skirt from the crests of the ilium, and it need neither be long nor heavy.

The Folly of Men's Hats.

The clothing of the ordinary man, despite great and serious defects which will be pointed out when discussing in detail the various articles of attire, is much to be preferred to that of the ordinary woman. Taken as a whole, it is superior in point of weight, warmth, looseness, and protecting power, and is infinitely better balanced and therefore more suitable from the standpoint of health. Yet the very first article we consider in detail is inferior from every point of view, for surely woman's headgear, except in point of price, is far in advance of man's.

The sole object of a hat ought to be to protect the head from rain and from the too-powerful rays of the sun. Now, it is true that most men's hats fulfil these functions, but at the same time they possess disadvantages which quite reverse the balance.

Whether we look at the bowler, the silk hat, or the cap, we will find that, whilst shielding the head from the direct rays of the sun, they enormously increase the heat of the scalp—to the extent frequently of 30° F., and at the same time, in order to retain their position on the head, they are pressed down so firmly that their rims seriously compress the arteries which are responsible for

conveying nutriment to the scalp. The bad results accruing from these serious defects are to be seen in the tremendous prevalence of baldness in men as compared with women. Doubtless there are other factors involved, such as the constant cutting of men's hair; but it is in the hat that the grand secret of baldness is to be discovered.

One of the effects of the close-fitting hat is to make the epidermal scales accumulate round the roots of the hair and encourage the growth of bacteria, which soon invade the hair follicle and produce around it a slight form of inflammation. This presses upon the root of the hair, which, being thus deprived of its nourishment, gradually atrophies, producing, as it does so, a hair which is progressively more and more frail and devoid of pigment. Finally it dies, and the dead hair is expelled. The epidermal scales set up an irritation which is responded to by the sebaceous glands, and these manufacture an increasing quantity of oily fluid which is extended over the scalp, the final result being dandruff or scurf, the most deadly enemy to the health of the scalp which we know.

The use of hair lotions and washes only leads to the removal of all the loose hairs by friction, and, as the cause of the disease is still in existence in the shape of an unhygienic hat, there is no improvement in the condition, but rather the reverse. Hence the constant complaint of people that the many proprietary articles advertised for the cure of baldness are useless and only hasten the completion of the calamity.

The Treatment of Baldness.

What is wanted, is to do away with the tight hatband and the dark noisome covering comparable to the "cloches" in a French garden, and vigorously massage the scalp and move it to and fro on the cranium with

the object of increasing the blood supply of the hair follicles and cleansing the pores from the impurities which so effectively block their passages. In most cases, however, it is necessary, in addition, to cleanse the head thoroughly at least once a week, and this is done by shampooing with the following shampoo liquid :—

Oil of lavender, 10 drops; rectified spirit, ½ oz.; soft soap, B.P., 2 oz.; distilled water, to 6 oz.

After careful drying apply the following lotion through a sprinkler, shampooing with the fingers for five minutes :—

Beta-naphthol, 5 drms.; proof spirit, 15 oz.; tincture of quillaia, 15 oz.; glycerine, 10 drms.; essence of bouquet, 6 drms. Mix and filter.

Keep the head covered for half an hour, and then dress the hair with a little carbolated brilliantine.

Castor oil, 2 drms.; almond oil, 4 oz.; glycerine, 6 drms.; carbolic acid, 2 drms.; absolute alcohol, to 6 oz.

After a few weeks of this treatment a stimulating hair lotion will be required, and the following are two good examples :—

Tincture of cantharides, 1 oz.; ammonia, 1 oz.; oil of sweet almonds, 2 oz.; spirits of rosemary, 2 oz.

Or,

Nitrate of pilocarpine, 1 gr.; glycerine of borax, 3 drms.; rose water, to 8 oz.

These, however, will be of no avail if the hair follicles be destroyed, nor will they serve their purpose unless the headgear be altered so that air can freely reach the scalp, and the arteries which supply its nutriment be relieved from compression.

Another very troublesome ailment which I have seen

A Source of Neuralgia.

arise from this latter cause is "supraorbital" neuralgia. It has often been said that neuralgia is the cry of a nerve for healthy blood, and if this be so surely such an obvious cause as constriction of the arteries by a tight hatband should not be so frequently overlooked.

When so much has been said on the defects of the men's hats in ordinary use, one should be prepared with a suggestion for a satisfactory substitute, which is not such an easy matter. On the whole, however, I incline to the view that a Panama or other comfortable straw hat in the summer and a soft Jim-Crow hat for the winter-time is the most hygienic form of headgear. There always remains the possibility of dispensing with the use of the hat altogether, and many have been bold enough to brave custom to this extent, much to the advantage of their scalps and hair. But there are limits to this fashion, because, even although the original purpose of a head covering, namely, defence from violence, has been lost sight of, the subsidiary function of adornment which it serves cannot rashly be overlooked, not to speak of the rainy or sunny days from which our sensitive crania require some measure of protection.

The ordinary jacket, lounge or otherwise, is not all that could be desired, although it meets the exigencies of everyday life fairly well, especially when supplemented in the winter by a silk lining. It fails, however, to protect the loins like a frockcoat, and it also leaves the lower portion of the abdomen unnecessarily exposed. This difficulty may be easily overcome if a knitted woollen binder, or what is usually known as a lumbago belt, be worn, or (what is better) if the upper eight inches or so of the trousers be lined with Jaeger or other flannel.

Waistcoats are certainly the weakest item of a man's body covering. The sides and back are usually lined with Italian cloth just where protection is most necessary, and hence the lungs are left unprotected at their most vulnerable parts. All this can be obviated by lining them throughout with Jaeger, with a double layer at the back and sides.

The Weakness of Waistcoats.

In the winter a kind of knitted, woollen waistcoat called a Cardigan is most valuable, although a thick, woollen jersey for exercise will be found more comfortable and uniformly protecting.

For clothing the lower limbs a man is restricted to the use of trousers or knickerbockers with stockings. The former are undoubtedly warmer, although they are not so cleanly. Turning them up at the feet may prevent the lower edges from fraying, but only transfers the dirt to the folded-in portion.

Gaiters or spats may be advantageously worn in the dirty days of winter, both as an additional protection to the ankles and a means of keeping the trousers cleaner. One should never fail to brush carefully the nether garments, gaiters and footgear, at least once daily. The days are gone by when trousers used to be lined with some cotton or other washable material, which not only had the advantage of making them warmer and more durable, but could be removed and cleansed from its impurity.

It may be mentioned that pockets, as a rule, are ingrained with filth, and it is well to have them renewed periodically.

Braces should always be worn in preference to belts even during exercise, and care should be taken that no undue pressure is exercised by them on delicate parts. Otherwise inexplicable pains are frequently traced to

pressure of the braces, disappearing when the position of the trouser-buttons is altered.

Shirts and Collars.

The white linen shirt, with its stiff starched front, is now almost a thing of the past unless for occasional or evening wear. Its only redeeming feature from the hygienic point of view was that it so soon displayed the dirt and thus necessitated an almost daily change, so that those men who could afford to do so had the inestimable advantage of each morning interposing a perfectly clean garment between their dust-ingrained outer clothing and their sweat-saturated under-clothing.

But it was ever a treacherous garment, though withal it imparted a feeling of comfort, and is wisely replaced by the woollen shirt of varying thickness according to the season of the year. On occasions when the wearing of a white shirt becomes necessary, such as the donning of evening dress, heavier under-clothing must be worn than usual, to avoid the risk of catching cold, unless, indeed, one happens to belong to the leisured class who can afford the time and expense involved in dressing for dinner each evening, a most delightful practice, to be commended as much for its effect on the mind as on the body.

The collar, with its ever-changing shapes, is a puzzle to all hygienists, as it is universally worn without any rational purpose. It restricts the movements of the neck, constricts the blood vessels passing to the brain, irritates the lymphatics in the delicate cervical region, and when frayed at the edges rapidly produces little abrasions in which germs set up boils and carbuncles. When limp with perspiration it extracts too much heat from the underlying skin, and rheumatic pains, usually described as "crick" in the neck, speedily arise. It is most inefficient as a protecting agency, and should never

be worn where courage will avail to don a soft silk or woollen substitute. It is, however, unwise to encourage the wearing of too much covering on the neck, on account of the risk of catching cold when any part of it is left off, and this remark applies with equal force to such articles of clothing as silk or woollen scarves or cravats, which are rarely necessary.

Gloves are of value not only to protect the hands from cold but also from dirt, and may be obtained in any material from silk to fur. A recent innovation is a double-layered cotton glove made in imitation reindeer, which is cool in summer, warm in winter, washable and moderate in price.

The Indispensable Overcoat.

Overcoats should never be omitted from the wardrobe, although they are looked upon as a sign of debility by some who prefer to brave the rigours of winter without one, and frequently catch pneumonia or other respiratory disorders for their folly. It is, however, important to modify the thickness of this garment according to its purpose, and so, whilst a thick, fur-lined coat may be worn for driving or motoring, something of moderate thickness only may be required for walking purposes. Weight is not always synonymous with warmth, and nothing is more fatiguing than walking about in a heavy overcoat.

It is a much wiser plan to order two overcoats at the same time, a Chesterfield of moderate thickness for walking and a waterproofed tweed overcoat, made to fit loosely over the former, which can be used as a mackintosh, and also, when occasion demands, for wearing along with the other overcoat for extra warmth in driving or travelling. This is simply carrying out the principle of an extra layer of air without any unnecessary weight to carry. Any one possessing these two garments need

hardly invest in a rubber mackintosh, which is, however, valuable as a protection against both cold and wet in those whose occupation demands considerable exposure but little exercise, such as drivers and sailors. For those who are taking exercise, such articles of attire are worse than useless, because while they may save the outer clothing from becoming wet, the moisture is only transferred to the under-clothing; the excessive perspiration is unable to disappear by evaporation in the usual way, because of the impervious texture of the mackintosh, and the surface of the skin is maintained in a most unwholesome condition.

To Harden the Feet.

Socks and stockings should always be made of pure wool of convenient thickness, as these will be found much more comfortable for walking and warmth, both in summer and winter, than silk, cotton, or any other woollen substitute. They should be changed often, the frequency depending on the amount of perspiration emanating from the wearer's feet. Where this is excessive, and especially when it is accompanied by an unpleasant odour (a condition known as "bromidrosis"), means should be adopted for overcoming it. One of the simplest methods is to bathe the feet each evening in a warm saturated solution of boric acid, at the same time soaking the socks in the solution, and after wringing out the excess of fluid leaving them to dry over night. In the morning a little extra boric acid may be powdered into them before putting them on.

This, however, is only suitable for slight cases, and is of no avail in those where not only the sufferer, but all who come into contact with him, have their sense of smell offended. One of the important items of treatment for the latter is the use of alcohol, which is certainly of more value to the feet than to the head, and

has the property of hardening the one if it softens the other. The bathing process at night is conducted with a solution of salt and water, or alum and water, and, after careful drying, the feet are sponged with methylated spirit. The stockings may be soaked in the boric acid solution as before and allowed to dry, but in the morning the following powder is liberally applied both to feet and socks:—

Oleate of zinc powder, 1 oz.; boric acid, 1 oz.; powdered talc, 2 oz.; powdered wheaten starch, 4 oz.

A modification of this method is also suggested as a means of preparing the feet for a long walk. For four weeks before the walk bathe the feet every morning and evening in tepid water, using ichthyol, superfatted or carbolic soap. After drying, bathe them with a lotion, consisting of equal parts of spirits of wine and tincture of hamamelis, which is an excellent hardening agency for the skin. Then use the above powder.

All sorts of remedies have been suggested for cold feet, but in my own experience none has exceeded in value the following method. Carrying out the principle of layers of clothing, a pair of thinner socks should be worn under a larger pair of slightly thicker socks, the boots or shoes of course being made a little larger than usual. If, then, the feet, socks, and insides of the shoes—for shoes are not only better but more easily warmed than boots—are thoroughly warmed before starting out in the morning, and if, in addition, a good pair of spats or gaiters be worn, little fear need be entertained of cold feet during the rest of the day. These measures I have found more successful than the use of loofah, asbestos, or other soles, although such could easily be used in addition.

Boots and Shoes.

The important problem of foot-gear is one that must be left largely to the individual. It is quite certain that for perfect insurance of comfort one must have boots or shoes made to order, but if the manufacturer insists on measuring by the antediluvian method of fitting a gauge with a sliding mark on the heel and big toe, the results are likely to be disappointing, even if the width of the feet be likewise taken at three different places. The advice to have lasts made is much sounder, but the great difficulty is to find a man who knows how to measure for them, or, when this is done, how to make them.

In all ordinary types of foot-gear the hygienic interest has been sacrificed to the æsthetic. Many types of boots and shoes have as little likeness to the shape of the foot as an ancient coracle to a modern yacht. They are broad where they ought to be narrow, and narrow where they ought to be broad; high where they should be low, and low where they should be high. So-called "reforms," moreover, have generally consisted of replacing one defect by another.

The two essential qualities of foot-gear are good fitting and resistance to damp. The American invasion of the English shoe market drew the attention of the shoemaker very forcibly to the first of these points, for whatever success the American shoe attained in England was solely due to the greater attention which the makers gave to the anatomy of the human foot. It was in their failure to meet the second requirement that the American shoe was disappointing, the outer soles being made of leather which could not compare with that tanned in England. Luckily for his reputation and fortune, the British manufacturer woke up to his business and is to-day supplying an article immeasurably superior in construction to that of ten or twenty years ago.

The points to observe in being fitted with boots or shoes are these. The shoes must be perfectly easy and comfortable when first tried on, without, however, being loose in any part; they should be from half to three-quarters of an inch longer inside than the foot, and particular care should be taken to see that they fit closely, without any puckering of the leather under the arch of the foot on the inside. The inner edges of the soles should be almost straight, and the outer edges should curve inwards towards the toes, the welt on the outer edge being broader than on the inside. The toes should be broad but not square, the heels broad and low, and the soles in thickness not less than five-sixteenths of an inch for men and quarter of an inch for women.

Ready-made boots and shoes of excellent quality are obtainable embodying all these points, though the purchaser may not always succeed in lighting on them. If one is unable to be fitted the only remedy is to have a pair of lasts made, and care should be taken to have the feet measured by the man who is going to make the lasts.

High Heels and Pointed Toes.

The anatomy of the foot is such that, in walking, the heel first comes into contact with the ground, and even in standing by far the greater portion of the weight of the body is borne by the heel, the rest of the foot, including the arch, being by way of a support, especially during fatigue.

Where, however, the heel of the shoe is excessively high, the tendency is to throw too much weight upon the ball of the foot, and, as there is usually no room for lengthening or spreading, the end of the big toe comes into contact with the toe-cap; the great toe joint is little used, becomes inflamed, thickened, and fixed, and too much strain is put upon the ligaments in the arch of

the foot. The result is that these become stretched and the condition known as flat foot supervenes. Where the occupation entails much standing, causing much muscular fatigue, the deformity is more easily produced, because vigorous muscular action has much to do with preserving a healthy foot. In these days of nervous exhaustion it would be well if all shoes were specially strengthened at the instep or arch, so as to obviate this tendency to relaxation of the ligaments, and where the deformity is already established a supporting arch should be worn inside the boot. In addition to this, improvement in the general health and the institution of special exercises for toe and foot drill will help to mend matters.

A much more painful if not more serious deformity is produced when the toes of the shoes are pointed, because then the great toe is pushed outwards and its joint much enlarged and thickened, producing the affliction known as bunion. The only treatment necessary for this in the early stages is to remove the cause by providing properly fitting boots and drawing the great toe inwards to its natural position and fixing it there by strapping. When the condition is more severe a toe-post must be fixed in the boot and the part painted with liniment of iodine to reduce the swelling, or where much pain exists a lead and opium lotion may be used with advantage.

Hammer or "trigger" toe is the result of a still more serious pointing, and at the same time shortening of the boot, so that in its desperate efforts to make room for all the toes the big toe is packed under the second, which becomes doubled upon itself.

In-growing toe-nail is still a third painful condition to be attributed entirely to the fashionable tapering toe so much in vogue. No treatment will avail unless the undue pressure be removed, and then in mild cases the

following method should set matters right. First trim the free edge of the nail straight across without rounding off the angles, then scrape the back of the nail with the edge of a knife or piece of glass, so as to reduce its thickness and produce a tendency to curl upwards or backwards away from the edges, then remove any cuticle accumulated under the in-growing edges of the nail. A little piece of lint may be gently inserted between the tender overhanging skin and in-growing edge and left for a few days, when it may be removed and the space filled with boric acid powder. In severe cases of this, as of the other two troubles, operation may be necessary to give relief.

The Cure of Corns.

Minor discomforts due to ill-fitting foot-gear are corns, callosities, and chilblains, which may all be prevented by comfortable boots or shoes. A corn is simply an overgrowth of the epidermis brought about by pressure, and is really an effort of nature to prevent more serious damage. The hardening takes the form of a corn, and, pushing inwards to the soft parts, impinges upon nerves, with excessively painful results. There are hard and soft corns, the latter being recent and as a rule between the toes. They are most easily removed by any softening application, such as glycerine, soft soap, or the salicylic acid ointment about to be mentioned. Hard corns can never be got rid of without first paring them with either a knife or a razor or using one of the rubbers or saws now on the market. Thereafter some form of salicylic acid must be applied, and herein is room for ingenuity.

The simplest method is as follows :—

> Salicylic acid, 1 drm.; extract of cannabis indica, 1 drm.; flexile collodion ($\frac{3}{4}$ strength), 1 oz.

Paint this on night and morning and occasionally pare or

scrape the corn, at the same time renewing the coating, and soon the hardened epidermis will come off.

For temporary protection of a corn chemists sell little rings of felt, which are pasted on the affected part with the corn in the centre. It is to be noted that boots which are too large are quite as apt to cause corns as those which are too small.

Callosities are almost always found on the sole of the foot, and are produced by the skin being thrown into ridges by a too narrow sole. They are to be treated in the same manner as corns.

Chilblains are not necessarily due to ill-fitting boots, but these are nearly always a factor in their production, although a weak circulation and injudicious exposure of the feet to cold, followed by the heat of the fire, are usually the exciting causes. The itching is easily got rid of by rubbing with ichthyol ointment, and the ailment may be cured by the administration of ten grains of chloride of calcium well diluted three times a day for two days.

Shoes better than Boots.

Shoes should always be preferred to boots, not only because the ventilation of the foot is better, but because they in no way hamper the action of the ankle, which is thereby strengthened. For extra warmth gaiters may be worn, and shoes with gaiters are always warmer than boots with or without gaiters.

Patent leather shoes should not be worn regularly or continuously, on account of the impediment they offer to proper evaporation of the perspiration.

Rubber overshoes or snow-boots as a temporary expedient in wet and snowy weather are extremely valuable. For those who have much walking to do in wet weather, hob-nails or tackets are a great protection to the soles of the shoes, and prevent the evils of "wet" feet. Wet

clothing of all kinds is really worse than none, for the moisture extends through the texture of the material and removes heat from the body by evaporation. It has been calculated that if the boots and stockings are thoroughly wet and allowed to dry on the feet they will remove as much heat as will raise half a pound of water at 32° F. to boiling-point.

The final point in connection with this subject is to mention the great relief afforded by the use of rubber tips or rubber heels when walking on hard pavements for a length of time.

Little need be said about night attire, which should always be made of some flannel material. In the winter-time pyjamas of some well-recognised knitted type, with bed socks, will be found much warmer than shirts. When sleeping in the open air or with the bedroom window fully raised, there can be no objection to a flannel or silk nightcap for protection against draughts.

Bed-clothing should never be unnecessarily heavy, and a light eider-down quilt will be found equal to many heavy blankets.

Working men of all kinds engaged in dirty occupations should either wear overalls or be provided with a second suit of clothing which they can don on their way to and from work. The time will necessarily come when the municipality, which provides electric trams for all and sundry, will be compelled to insist on the provision of washing and dressing-rooms in dirty factories, so that the workmen may be able to travel to their homes without the possibility of soiling the clothes of their fellow-travellers. It is perhaps premature to suggest that, just as underclothing should be washed at weekly or fortnightly intervals, so the outer clothing should be subjected to periodical cleansing.

Catching "Cold."

We are now in a position to answer the constantly occurring question, "How to avoid catching cold." It is particularly unfortunate that the word "cold," which, after all, only designates a possible cause, should be used as the name of a disease. There is very little doubt that exposure to cold is one of the most common causes of acute rhinitis or nasal catarrh, especially the exposure of those parts of the body ordinarily protected by clothing. But as only a small proportion of those who are exposed to cold succumb to this troublesome affection, there must be some special reason for its unequal distribution.

The truth is, that nasal catarrh is due to the invasion of a microbe which, being transferred from one person to another, will only grow on a specially prepared soil. In other words, the nasal mucous membrane of the man who is said to catch a cold must be supplied by a special quality of blood which will provide a growing medium or soil for the growth of the germ. There is not necessarily any gross alterations of the lining membrane of the nose, although this is extremely common, but there is usually habitual engorgement of the blood vessels, making the soil tolerant and receptive of the germ.

Such a condition is more or less constant in the man who does not live in the open air as much as possible and who fails to take an effective morning bath. It is not necessary that this should be cold (as has been explained on the section on "Bathing"), but it ought to be of such a character that it will really cleanse the body, and at the same time tone up the blood vessels of the skin and train them to contract readily and so to resist the cold. Then overheated rooms and too much body and bed-clothing must be avoided. But when all

this has been attended to there are still to be found those who are subject to frequent attacks of nasal catarrh.

In many cases it will be found that repeated colds have caused a thickening of the nasal mucous membrane, which will require attention from a doctor, or that it is being subjected to daily irritation by millions of particles of heated dust in the shape of tobacco smoke. No more potent stimulant for the growth of germs can be imagined than tobacco smoke. A Consequence of Smoking.

Another factor which is far too frequently overlooked is diet, and after a careful consideration of the problem I incline to the view that quantity rather than quality of food is the predominant factor in the predisposition to nasal catarrh,—always excepting indulgence in alcoholic liquors. I have been led to this conclusion by noting that vegetarians as well as meat-eaters, children as well as adults, and open-air workers perhaps most of all, are subject to colds in the head. Indeed, it is quite a common occurrence for catarrh to attack a man after a long spell of exercise in the open-air, *e.g.* on his return from a holiday. The explanation lies in the fact that his appetite was sharpened and he ate a good deal more than was absolutely necessary for the waste and repair of the tissues, and so long as the residence in the bracing air continued the excess was burned up and no harm ensued. This good appetite was carried back to town and gratified as formerly, but without the same ability to utilise the excess, because town air is deoxygenated and devitalised. As the accumulation of combustible material must be got rid of somehow, the "fire" takes place in the respiratory organs, and a nasal catarrh or bronchitis is brought about.

A similar explanation may be given of summer colds,

as we are apt to go on eating the same amount and kind of food as in the winter, with the results above mentioned. Probably some foods and food accessories are more damaging than others, *e.g.* excess of common salt is responsible for setting up nasal catarrh quite frequently.

To diminish, therefore, the tendency to catch cold it will be necessary: (1) To take a daily cleansing bath, which need not be cold but should not be hot. (2) To wear appropriate clothing. (3) To take sufficient open-air exercise. (4) To restrict the amount of food to the necessities of the body. (5) To diminish the quantity of salt and irritating food accessories, like pepper, mustard, etc. (6) To cease smoking. (7) To use the method of cleansing the nasal passages mentioned in the chapter on "Cleanliness." The great value of this last practice consists in the fact, that not only does it cleanse the parts from dirt and microbes and render the mucous membrane more healthy, but it washes away the excretions of the microbes, which are called sepsins or toxins, and which, when they are absorbed into the body, are apt to set up diseases at points remote from their origin.

Practical Summary.

1. To retain the bodily heat, it is essential that a plentiful supply of good food be eaten.

2. To retain the necessary amount of bodily heat for comfort, clothing should be worn of seasonable thickness, but it should always be as light as possible.

3. Wool for all practical purposes is the best material for both outer and under-clothing, because it can contain more air and absorb more moisture, without feeling wet and cold, than any other material.

4. "Hardening" is a great blunder. Sufficient clothing to keep the body warm should always be worn.

5. The clothing of young children and infants needs revision. Bare legs and white socks are an anachronism.

6. The weight of a woman's clothing should be equally distributed as far as possible, neither altogether depending from the shoulders and so interfering with the breathing, nor from the waist and so compressing the internal organs.

7. Corsets, if sensibly constructed, are not without value.

8. Hard-brimmed hats should never be worn, as they cause baldness and are apt to induce neuralgia.

9. Waistcoats are dangerous, unless lined with flannel.

10. Soft silk collars are to be preferred to stiff linen.

11. Boots and shoes should be made on a last if necessary, and constructed on sensible principles.

12. Colds cannot always be cured, but can almost always be prevented.

CHAPTER X.

MODERATION.

LAW IX.—"Regularity and moderation should be the watchwords of the whole life."

The Centenarian's Secret.

THE secret of longevity lies in the practice of these two virtues, as can be attested by every centenarian. An examination of the formulæ prescribed by every "grand old man" will reveal a curious diversity of detail, but the underlying principles will always prove to be the same. Moltke, at the age of ninety, said the secret of his good health and long life was, "Great moderation in all things and regular outdoor exercise." Crispi, in an interview, declared that "regularity and abstinence are the secrets of long life."

The classical case of Cornaro will occur to every one. A physical wreck at the age of forty, he adopted a system of extreme temperance in eating and moderation in drinking, partaking of only twelve ounces of mixed food daily and fourteen ounces of red wine, gradually diminishing this quantity as he grew older, and died peacefully in his arm-chair at the age of one hundred and three.

The statement that a man is either a fool or a physician at forty doubtless owes its origin to the fact, that unless a man has estimated his own capacity for

eating and drinking and for work by the age of two-score he has been guilty of the great crime of failing to exercise his faculties of observation and common sense, and, as his power of accommodation to adverse circumstances decreases every day after middle age, he is more than likely to suffer for his folly. The whole object of this book is to enable a man to acquire that information whereby he may most easily "know himself," and to put into practice principles of action whereby he may convert himself from an easily transgressing individual into an instinctive votary of hygienic wisdom. He will attain to this state in proportion as he recognises that the constant repetition of an act leads to its better performance, and that by regularity he will not only save time but also tend immensely to the conservation of his energy.

A careful consideration of the methods whereby Nature attains her ends in the working of his body will show him that all its unconscious movements are characterised by regularity and perfection of rhythm. The beating of his heart, the movements of the muscles of respiration, the secretion of the digestive fluids, the peristaltic action of the stomach and bowels are all outside of his own control, and answer their purposes in the most efficacious manner, chiefly because they are carried out with the perfection of rhythm. No education is required to enable these organs to fulfil the requirements of the human economy; their operation is perfectly spontaneous, and yet they are complete examples of what is known as reflex action, which is at the root of all regularity and the means whereby we are accustomed most easily to acquire good habits.

Habit is said to be "a second nature," because it enables the body to repeat the same process over and

over again without the necessity of calling upon volition to step in, and indeed the good results obtained depend largely upon the exclusion of volition altogether. The vast majority of our daily activities are performed automatically and habitually, thus saving an immense amount of fatigue to our bodies and ensuring an exact reproduction of any process we may require from them. We can hardly remember the painful steps and slow whereby we learned to walk, but most of us can appreciate the stupendous saving of labour encompassed by habit when we recall our first efforts to play the piano or manipulate a typewriter. Every action had to be backed up by a separate effort of the will, which is completely eliminated when we are transformed into the accomplished pianist or typist.

"Reflex" Actions.

The mechanism involved in this process is described more fully in the chapter (XI.) on "Cheerfulness," but consists briefly in the acquisition of reflexes by regular repetition of the movements in question. A reflex action is one which takes place without consciousness, and the mechanism required for its performance may be thus described—(1) The stimulation of a sensory or afferent nerve; (2) the stimulation by this of an intermediate nervous or reflex centre; (3) the stimulation by this of an afferent or motor nerve producing muscular or other action.

A simple and convincing example of reflex action is that of swallowing, because every one knows that when the stimulation of the sensory nerves in the throat and in the tongue has proceeded to a certain point it is impossible to prevent the action of the muscles of deglutition, because the excitement of the centre in the medulla oblongata has compelled their contraction. Sneezing, winking, convulsions of teething, grinding of

teeth from worms, micturition, and even blushing are all examples of simple reflex action.

What is called the "superposition of reflexes" is explained by the diagram in Chapter XI., and enables one to comprehend the possibilities of the more complex reflexes and the statement that we are merely bundles of habits. As this, therefore, is what we always tend to become, it is important that care should be exercised by ourselves and others that we should obtain that particular agglomeration of habits which shall be most useful to us all through life. A process of education is therefore necessary in order to teach us how to behave in all circumstances, and habits are simply the stuff of which behaviour consists. "Conduct is three-fourths of life," and perfect conduct can only be acquired by careful training from the first.

It is true economy to take pains to make our bodies our servants and not our masters. For example, take the simple habit of efficient mastication, which is so essential to a perfect digestion. Most children, and sorrowful to relate most men, are in the habit of bolting their food unmasticated, for, despite the provision by Nature of thirty-two grinding surfaces for its trituration (indicating the vast importance of that process), two or three champs of the jaws are held to be sufficient, and a draught of fluid completes the perfunctory dispatch.

Now, nothing is more easy than to acquire the habit of perfect mastication, if sufficient pains be taken, but this can never be effected without deliberate attention to the act and (just at first) the actual enumeration of the bites practised on the food. Needless to say, there is no special number of bites necessary for adequate mastication, but it is wise to insist on anything from seventy to

one hundred, and in most cases this will rarely be found too many for the proper comminution and effectual insalivation of the food. If, during every meal for a week, this process be religiously indulged in, it will be found that thereafter no special attention is necessary, because the moment the food is popped into the mouth the sensory nerves of the tongue and teeth stimulate the cerebral centre, which impels the effective action of the muscles of mastication. (See p. 10.)

The reward for such careful training of the mechanism is a perfect digestion for life, and even in most cases, where neglect of the practice has led to serious dyspepsia, it is only necessary to retrace the steps along the paths of physiological rectitude to ensure the same good results.

In many cases of constipation a cure may be effected by the simple procedure of attending regularly to the evacuation of the bowels at a stated time every day.

Habit and Happiness.

It is a wise procedure to relegate to habit as far as possible most of the health hints inculcated in this volume. There is nothing so easy as to develop the habit of deep breathing, not only at stated intervals but all through the day. By this means an infinitely greater supply of oxygen is available for blood purification, and many of the evil effects of city life are checkmated. The regular practice of water drinking early in the morning, last thing at night, and between meals, with all its undoubted benefits, needs only to be inaugurated and it will perpetuate itself. The open window is looked upon as a modern innovation, though it was practised and recommended by Benjamin Franklin. Once started, there is little fear of this habit being dropped, as foul air becomes less and less tolerable to the senses, and the same applies to that buoyancy of temperament, the

importance of which to sound health is enlarged upon in a subsequent chapter.

The customs of modern society and business fortunately render it essential that meals should be taken regularly, and the condition is a fortunate one, because our digestive organs accommodate themselves to such procedure with greater ease. This is doubtless due to the fact that we get accustomed to eating just the proper quantity and quality of nutriment to last till the next meal is due. Although variety of food is counselled, and with much show of authority, it is also a fact that any great change of diet is apt to be followed by discomfort. There is much justification for the statement that this is due to interfering with the stomach's habit of secretion, because Pawlow has demonstrated that the system comes to provide the precise quantity and quality of digestive fluid required by its accustomed task. If, therefore, we eat food which requires a greater or less quantity than is customarily secreted, the stomach's arrangements are disorganised.

There is no practice essential to the maintenance of health which cannot by regularity be made reflex, and so carried on automatically and accurately with valuable results to the bodily functions. Hence, cleaning the teeth night and morning and after meals, exercising seven or eight minutes each morning, bathing just after the exercise, are all quite easily sandwiched into the day's proceedings with advantage and with hardly any appreciable loss of time.

The regular worker knows how uncomfortable he feels when for any reason other than that of a legitimate holiday his work is interrupted; and when this cessation of work is long continued it ends in demoralisation. Just as little can he tolerate the loss of his sleep or his

rest, and for most of us the regular alternation of work and rest is the best guarantee of continued health and vigour. That man lives best who does his best for one day at a time, and then refreshes himself for his level best the next day.

Tyrannous Appetites.

So far we have only been dealing with the regular practice of helpful health-giving habits. But it is just as easy to get the body accustomed to other habits whose value is more open to question. The ease with which we develop a habit is readily recognised in connection with what are usually spoken of as bad habits. We speak of a "craving" for certain substances, *e.g.* alcohol, morphia, cocaine, tobacco, tea, coffee, etc. This craving, in the case of drugs, is a condition in which the nervous system is unequal to the performance of its ordinary duties until it has been "wound up" for a time by its accustomed drug. The smoker finds that he cannot shoot or fish or play billiards so well until he has had his smoke, and so with the tea-drinker. Tobacco and tea, when taken in moderation, are undoubtedly of great service to many people, although in the nature of drugs; but it is well to recognise that the desire for them is a craving, and, if gratified to an inordinate degree, may easily master us. All judgment condemns the man who takes alcohol, morphia, or cocaine to excess, and yet his fault is identical with that of indulgence in any habit detrimental to the body.

Many people suffer severely from chronic recurring ill-health who are regularly, though mayhap unwittingly, satisfying some craving of their appetites. When we feel that we are unable to resist some food accessory, or the pipe, or the fatal glass, it is high time to expunge it from our daily life, if we cannot keep it within limits. Tobacco, tea, and coffee are regarded as venial addictions.

Yet the first may be the cause of cold feet and palpitation, and the other two of the most violent indigestion. A distinguished member of the medical profession says: "Tea spoiled the twenty best years of my life, before I found it out. It gave me awful pains, almost anginiform, with the sense of palsy and weakness of the limbs, and a grey face, but there was no obvious change in my pulse." I can endorse every word of this statement from personal experience, and I would counsel great care in the admission into the daily life of any habit which may prove a subtle enemy of sound health.

The Self-Reformer's Programme.

Regularity may thus become our greatest foe as well as our best friend. Its influence is so great that it will always be found much more easy to acquire a new habit than to leave off an old one,—but the following rules, if carefully carried out, will enable us to reinforce that constant attention upon which success is so dependent. The late Professor Bain, of Aberdeen, is responsible for the first two, and I am indebted to Professor William James, of Harvard, for the others.

(1) When we have made up our mind to start on a new course we must launch ourselves with as strong and decided an initiative as possible. We must use every legitimate means to strengthen our determination, even employing those which may appear trivial to others.

(2) We must never suffer an exception to occur till the new habit is securely rooted in our life. If we have decided to go in for a bath each morning, and have had a fair start off, it is very unwise for any reason to omit it any morning, as we may find it more difficult to continue on succeeding mornings. We must strike firmly and keep on striking if we are to make a permanent impression on the enemy, which in this case is the plasticity of the nervous system.

(3) We must seize the first possible opportunity of acting on every resolution we make, and on every emotional prompting we experience, in the direction of the habits we may aspire to gain.

(4) We should not waste time in talking too much about our intentions, but carry them into action with energy. We may talk for months about going to New York, but until we set foot in the steamer we have made no real progress. It is pathetic to hear the expression of good intentions practically strangled at their birth, just as it is to hear regrets at wasted opportunities. Up to the age of thirty, Darwin was passionately fond of music and poetry, but thereafter was quite unable to enjoy them because he ceased to gratify his taste for them with regularity. The tracks made in the semi-fluid brain substance are easily obliterated by ceasing to use them, just as even a coach road will become overgrown with grass if it be for a time discarded. Daily effort is necessary to keep us in the wholesome path, and therefore it is necessary for us to

(5) Keep the faculty of effort alive by a little gratuitous practice every day. Regular exercise will prevent our muscles from atrophy, and preserve our wind; regular bathing will train our skin to resist the invasion of cold; regular meals will prevent indigestion.

We cannot cheat nature. We may occasionally neglect or ignore the laws of health, and think we have not suffered thereby, but an impression has been made or effected on our brain cells which is registered there for all time, so that when our reserves are called upon, balance of vital force to satisfy the demand has been wholly or partially embezzled. No matter how strong a man may be, he cannot continue regularly to expend more energy than he is able to manufacture, without

paying the penalty some day. No matter how weakly a man may be, he cannot continue regularly to obey the laws of health without one day reaping the reward in increased vigour and health of body and mind.

Moderation has been inculcated and practised in all ages. Abernethy's famous prescription " live on sixpence a day, and earn it," will be recalled in this connection. His original advice to a wealthy patient suffering from indigestion was to steal a horse, so that the incarceration which would be the outcome of this exploit would compel a parsimonious regimen and diet. Cyrus, the creator of the Persian Empire, subsisted from childhood on the simplest and plainest diet of vegetable food and water, whilst his soldiers adhered to the same rigorous fare. Edison tells us that for two months he lived on 12 oz. of food per day, taking absolutely no exercise, and retaining his weight of 185 lb. When working at serious problems, he is careless of sleep, and has done without it for five days and nights on occasion. The confession of physiological malpractice in the one direction is a striking testimony to the effects of physiological virtue in the other.

Moderation in all Things.

The long duration of life attained by many nervous dyspeptics is explained by the fact that they are forced to adopt a spare regimen, and do not get their organs overloaded with fat, whilst their intestinal digestion is well performed. Discomfort in the stomach is frequently a salutary process, and those whose stomachs tolerate anything in unlimited quantities are not wholly to be congratulated. Sydney Smith, the celebrated gourmet, was something of an authority on the question of moderation, for he declared that during his life he had devoured forty-one cartloads of meat and drink beyond the requirements of health, after which none need be surprised to hear

that in the evening of his days he was the victim of "seven distinct diseases." He says: "All people above the condition of labourers are ruined by excess of stimulant and nourishment, clergy included. I never yet saw any gentleman who ate and drank as little as was reasonable."

In the advocacy of moderation, however, we are not at the mercy of isolated examples such as we have mentioned. In these latter days the question has been put to the test of scientific experiment by Professor Chittenden, of Yale, who had the good fortune to be aided in his work by the co-operation of the United States Government and the Carnegie Institute, and in this capacity was enabled to investigate the matter on a large scale. The record of his experiments is so interesting that I give it here in detail.

A Remarkable Experiment.

He was not satisfied that the observations made by Voit and Atwater on the dietetic habits of the people had established the true physiological nutritive requirements of the body. The investigations made by Professor Atwater into the diet of fifteen thousand people cost the American Government $880,000, and Chittenden considered that they were not physiologically accurate. His aim, therefore, was to demonstrate the true nutritive requirements of the body as contrasted with the dietetic habits, and he required that during the experiment the following four points should be carefully kept in view:—

(1) That nitrogen equilibrium be maintained.

(2) That physiological equilibrium be maintained, *i.e.* the body-weight should not be reduced.

(3) That physical efficiency be maintained.

(4) That the body should retain its power of resisting disease.

He therefore selected men of the well-to-do class from various social grades—six brain workers (university professors and medical men); twenty men from the Army Medical Corps, representing the moderate muscle workers; eight university athletes, men working their brains moderately and their muscles excessively. From October 1903 to June 1904, every scrap of food and drink these men ingested was carefully weighed and measured, their daily excretions analysed, and at stated periods their "nitrogen equilibrium" was ascertained. By this means they were prevented from demonstrating the effects of moderation at the expense of their bodily tissues. The underlying conception was to find the smallest possible quantity of food on which the health, strength, and body-weight may be maintained while doing the accustomed work efficiently. We know that a superfluity of protein food is especially harmful, as in the body it is split up into compounds of which many are actually poisonous. These are slowly excreted, and in the process of excretion are apt to damage the kidneys, at the same time often originating headaches, fatigue, gout and rheumatism, etc.

For this reason, and because of ease of estimation, the problem was narrowed down to the discovery of the smallest necessary quantity of protein. Up to this time it had been considered that we required 120 grms. of protein daily, *i.e.* a little over 4 oz. Voit's diet standard, which is that most generally accepted, gives 118 grms. protein, 50 grms. fat, 500 grms. carbohydrate.

Sir Michael Foster's diet for moderate workers of about 150 lb. weight was 130 grms. protein, 68 grms. fat, 494 grms. carbohydrate. The results obtained by Chittenden are remarkable, and may be tabulated as follows:—

To maintain nitrogen equilibrium and body-weight, Foster says we require 130 grms.; Chittenden personally required 36 grms.; average for twenty soldiers, 50 grms.; average for eight athletes, 55 grms.

Nor were these results attained by taking increased proportions of fat and carbohydrate—a transposition which up to this time has been considered quite feasible. It was stated that 3000 large calories (units of heat) were necessary for the maintenance of the body. Chittenden found that he personally required, for a time at least, less than 2000 calories, whilst from 2000–2500 were ample for men doing hard work.

The details of this investigation are extremely interesting. Professor Chittenden himself was a hard-working man of forty-seven years of age, accustomed to live well, but he cut down his diet by degrees until he came to live on what at first sight appears to be starvation diet. The following are samples:—

7.45 *a.m.*, *Breakfast*—

One-third of a pint of coffee, with cream and sugar. No solids.

1.30 *p.m.*, *Dinner*—

Chicken . .	50 grms.	about	2 oz.
Mashed potato .	131 „	„	4½ „
Biscuits . .	49 „	„	2 „
Chocolate pudding .	106 „	„	4 „
Butter and crackers	42 „	„	1½ „
Total solids .	378 grms.	„	14 oz.

6.30 *p.m., Supper*—

Lettuce sandwiches, biscuits, butter, sponge cake, oranges and tea, the total solids weighing 8 oz.

The whole allowance of food for one day, therefore, only weighed 1 lb. 6 oz.—about two-thirds of what the average man takes three times a day.

The athletes appeared to fare very little better:—

Breakfast—

Bread	64 grms.
Butter	9 „
Banana	70 „
Total solids	5 oz.

One cup of coffee, with cream and sugar.

Lunch—

Boiled eggs	73 grms.
Fried potatoes	75 „
Bread and butter	70 „
Stewed apples	90 „
Total solids	11 oz.

One cup of coffee, with cream and sugar.

Dinner—

Bacon	35 grms.
Potato croquettes	47 „
Bread and butter	49 „
Chocolate	45 „
Total solids	$6\frac{1}{4}$ oz.

One cup of coffee, with cream and sugar.

The soldiers' diet was a little more generous, and had the advantage that it could be compared exactly with the food ordinarily consumed by American soldiers.

SPECIMEN ARMY RATION.

Breakfast—

Beef steak	299 grms.
Onions	21 „
Gravy	175 „
Bread	222 „
Total solids .	19 oz.

Coffee, milk, and sugar, 1 pint.

Dinner—

Roast beef	221 grms.
Potatoes	517 „
Bread	148 „
Gravy	154 „
Pie	184 „
Total solids .	38 oz.

Coffee, sugar, and milk, 1¼ pint.

Supper—

Roast beef	96 grms.
Potatoes	260 „
Onions	32 „
Bread	32 „
Jam	92 „
Total solids .	18 oz.

Coffee, milk, and sugar, ¾ pint.

Here is a sample of

PROFESSOR CHITTENDEN'S EXPERIMENTAL RATION.

Breakfast—

Griddle cake	200 grms.
Syrup and butter . . .	60 „
Banana	75 „
Total solids .	12 oz.

One cup of coffee.

Dinner—

Salt mackerel	25 grms.
Potatoes	250 „
Turnips	150 „
Bread	75 „
Stewed apples	150 „
Total solids .	23 oz.

One cup of coffee.

Supper—

Cabbage, pepper and vinegar .	100 grms.
Bread and butter . . .	95 „
Cake and cranberry sauce . .	275 „
Total solids .	16 oz.

One cup of coffee.

Thus, instead of 75 oz. of solid food and 3 pints of coffee, only 51 oz. of solid food and $1\frac{3}{4}$ pint of coffee were taken; whilst, instead of 22 oz. of meat in their former dietary, they now ate only 1 oz. daily.

The results of this dietetic restriction were still more

wonderful than the reduction in the quantity, for, although a diminution of weight occurred at the outset, it speedily ceased, and the weight then remained constant to the close of the experiment. The appetite soon became accustomed to the smaller quantity, work was done with greater ease and effect, and the spirits became lighter. Even the smaller meals were eaten with much greater relish than the larger ones, at which, of course, we need not be surprised. The most remarkable feature, however, was the increase of total strength and endurance, which on the average was 50 per cent., a sufficiently striking commentary on the value of moderation.

It has always been known that it was possible to live and work on remarkably small quantities of food; we have Dr. Rabagliati's statement, that no man should eat more than a pound and a half of food per day, and he personally restricts his allowance to nearer 12 oz. But these have been looked upon as isolated cases with special requirements. We have not hitherto known that it is quite possible to take thirty-one men at random and subject them to such a rigorous dietary with such beneficial results.

An Overlooked Point.

Now, whilst the facts we have just detailed are incontrovertible and form in themselves a powerful argument for moderation in eating and drinking, there are not wanting critics who assert that the experiment was not continued for a sufficient length of time, and who even place quite a different interpretation upon the results. It is pointed out that the standard diet based upon custom may be in excess of what is needed, and that economy is quite possible by being satisfied with (1) a lessened heat production, and (2) a reduction of the body-weight. Fat is not now so necessary as a reserve food

as it used to be when supplies were difficult to obtain. If there is too much adipose tissue, it can only cause a waste of energy. Protein, again, may be diminished largely if eaten along with carbohydrates and fat. When an equal number of molecules of protein, carbohydrates, and fat are at the disposal of the cells, the highest percentage of destruction is in the protein molecules, the next highest in the carbohydrates, and the least in the fat. If a small number of protein molecules and a relatively large number of carbohydrate and fat molecules be presented to the tissue cells, then the influence of the more numerous molecules asserts itself, so that the carbohydrate and fat are used up and become "protein sparers." It is therefore easy to maintain nitrogen equilibrium upon a minimum of protein when it comes to the tissues along with carbohydrates and fat. It is a common but wasteful plan to take protein at one meal and carbohydrates at another, as is frequently done in indigestion; but a vegetarian diet with carbohydrate and proteins intimately mixed, so that they reach the tissues at the same time, is one that lends itself to the maintenance of nitrogen equilibrium on a relatively small amount of protein. An infant of six months old consumes 14 grms. of protein in milk daily. It has therefore been computed that an adult on this basis should only require 74 grms. daily, which is much on a par with Chittenden's results.

But the protein minimum is not necessarily the protein optimum. The matter has to be considered from the standpoint of accumulating reserves as well as of meeting the normal and necessary expenditure of energy. A diet rich in proteins is supposed to increase the resistance of the body to infective diseases, especially tuberculosis, and there is a possibility of danger in

limiting the amount of circulating protein in case of emergency. Vegetarians long ago pointed out that it was not necessary to make up for low protein by an increase of carbohydrates and fat, and on a vegetarian dietary, as we have just seen, this is quite true, but discretion has to steer a course between these advantages and the dangers of superfluous protein above referred to.

No doubt Chittenden's low protein diet would be all right for eighteen months or two years, or even for longer in those accustomed to a sedentary mode of life, but by and by the vitality would be so lowered that it would affect the health in one way or another. It is a common experience that in times of stress and strain, as in famine times in India, it is the underfed that suffer most. The quantity of food required depends on the occupation, the ability to digest and absorb, and, above all, upon the size and weight of the individual. The standard diet is constructed for a man of 70 kilogrammes, and it is to be noted that vegetarian nations, in which a low protein consumption obtains, are composed of men much less in weight than this.

The weakness of Professor Chittenden's calculations is that they are too quantitative and insufficiently heedful of secondary consequences; thus the bodily weight of his subjects must have been actually kept up by the retention of water in the tissues in place of fat which was destroyed, and to which it was much inferior as a reserve of endurance and energy.

Protein and carbohydrate will sustain life indefinitely, whereas protein plus fat is effective only for a short time. The amount of protein really necessary for the continuance of life, in the absence of exceptional calls upon the system, is exceedingly small.

It is also stated that many of the men, especially the

athletes, returned to their former diet at the close of the experiment, and it has been suggested that in any case much of the benefit was due to the regular life and the unique form of social communion in vogue.

In order to determine the best amount of protein for its sailors, the Japanese Government commissioned two battleships, the one on 91 grms. of protein and the other on 155 grms. per man per day. The experiment lasted for close upon three years, and, as it was then discovered that the latter had much less sickness than the former, the larger amount of protein was adopted as the best.

There is another well-known experiment of two groups of ten cows each, which for three years were fed, the one on the usual diet, and the other on a low protein ration. At the end of two years the latter group had lost weight, but their physical tone was good. In the third winter, however, they began to fall off in flesh, and their coats became exceedingly harsh, so that the protein had to be increased.

When, however, every objection has been carefully considered, we are entitled to hold that convincing testimony has been recorded in favour of moderation.

Diet and Exercise.

With the above facts in our possession, the conclusion seems inevitable that extreme conditions must be present before people can die from the effects of taking too little food. There are other factors in the situation when deaths are recorded as being due to starvation. Cold, dirt, badly ventilated houses, lack of a desire to live in a depressing environment, have much to do with the physical deterioration of the poorer classes.

It is fairly certain that the good results of conflicting dietary "reforms" depend upon the one point in which they all agree, namely, reduction in quantity, which is

of far greater importance than the chemical constitution of the dietary. There is a very general impression abroad that as a nation we are given to over-eating, and reflective people often inquire how they may check this propensity.

Speaking frankly, I do not consider that the average man who employs his days in hard work and takes regular exercise is at all likely to over-eat himself, and I am sure that the man who follows the laws of health as taught in these pages will not err in that direction.

It is quite a different matter, however, with the man who gets so immersed in business affairs by the age of forty that he forgets his exercise and other forms of recreation. The good appetite he has developed before middle life is apt to continue and be gratified, and the excess is either deposited as fat or excreted by kidneys, liver, bowels, and lungs with a great loss of energy and much overwork in the organs mentioned. One or other of them is, therefore, apt to become diseased. The heart, also, has more to do than it can overtake, and hence is liable to become dilated or otherwise degenerated. Over-eating is usually accompanied by an over-indulgence in alcohol and other stimulants or narcotics, and this is the secret of many a breakdown before the age of fifty, and the development of some degenerative change in the tissues which may lead to an early death.

The practice of moderation should not cease with eating and drinking, but should be carried out in relation to all the issues of bodily life. It will not be necessary to enter into further details on these points, as each must be satisfied in his own mind as to what constitutes moderation, and a knowledge of his constitution and temperament will be the best guides in the matter.

Practical Summary.

1. It is generally agreed by centenarians that regularity and abstinence are secrets of long life.

2. The adoption of regular habits of life not only saves time, but tends to the conservation of energy.

3. The sooner we can arrange that most of our physical activities are relegated to the region of habit, the better for our bodies.

4. Most of even our unconscious activities can thus be brought under control, *e.g.* digestion, by efficient mastication.

5. Most cases of constipation are due to failure to attend regularly to the evacuation of the bowels.

6. Regular meals are of prime importance.

7. Regularity in the practice of bad habits is equally potent in enslaving the body.

8. An unnatural "craving" can only be got rid of by refusing to continue the practice of the bad habits.

9. Chronic or recurring ill-health is often due to what may be unworthy satisfaction of a craving of the appetite.

10. When we cannot resist some food accessory such as tobacco, alcohol, tea, coffee, etc., it is high time to expunge it from our daily life. Even tea and coffee may be the cause of much bad health.

11. The acquisition of good habits is not a formidable task if we only regularly and intelligently practise them in time.

12. Moderation is of equal value with, and practically includes, regularity. This is especially true of our eating and drinking.

13. Science has demonstrated that it is possible to live and work on exceedingly small quantities of food,

although extreme asceticism may ultimately injure the vitality. It is therefore unwise to over-eat.

14. The man who practises the laws of health as inculcated in this book is not likely to over-eat. One valuable index of over-nutrition is excess of fat.

15. The practice of moderation should not be limited to eating and drinking, but should be carried out in relation to all the exigencies of bodily life.

[During the early part of this year 1909, I spent some time at Yale University observing the important work which is there carried on by Professor Chittenden and his assistants. I desire to record here the unvarying courtesy with which I was treated and the valuable assistance given to me in my investigations. I had the good fortune to return to England in the same boat as Professor Chittenden, who during the voyage very kindly revised the type-written manuscript of this chapter. In accordance with his suggestions the text has been altered here and there, but this in no way reduces the strength of the argument for moderation. I also take the liberty of recording a few of Chittenden's observations on the criticisms of his prolonged experiment without desiring to assume the responsibility of stating that it is in any way a complete answer to his critics.

Chittenden contends that in health it would be impossible to maintain the body-weight for more than a few days by the retention of water in the tissues in place of fat which had undergone destruction. It would be quite out of the question for this to happen during an experiment lasting over two hundred and twenty-five days.

Regarding the statement that a diet rich in protein increases the resistance of the body to disease, he quoted Dr. Reid Hunt's experiments at Washington. Two groups of dogs were fed on a low protein and a high protein diet respectively. After a period of this feeding they were subjected to the influence of the same poison. It was then found that the dogs fed on the low protein diet could withstand three times more of the poison before succumbing to it than those fed on the high protein diet.

With reference to the experiment made by the Japanese navy, when an increase of the protein in the diet caused such an improve-

ment in the health of the crew, it is not necessary to infer that this was due to the protein *per se.* Protein pure and simple is not easily utilised in the body as a food. It is almost certain that it must first become a salt of calcium, potash or soda before it can become available as a food. The influence of these and other mineral salts on the nutrition of the body is not well understood, but it must be great, as witness the ravages of scurvy before the days of lime juice.

The diminution of Beri-Beri, therefore,—said to be due to the increased protein in the diet of the Japanese navy,—may very well have been produced by the increase of the mineral salts in the more liberal dietary.]

CHAPTER XI.

CHEERFULNESS.

LAW X.—"Cultivate cheerfulness, hopefulness of mind, and placidity of temper. Much may be done by constant practice to secure these desirable endowments, even for those of a pessimistic temperament."

Mind and Body.

THE influence of the mind over the body has been appreciated in a general way from the very earliest times, but, thanks to Braid, Hack Tuke, and Schofield in the medical profession, as well as a host of irregular practitioners in these latter days, our information has become more precise and definite, so that it is now in a fair way to be utilised as a therapeutic agent and take its place as a branch of the healing art. If we would realise in the fullest degree how cheerfulness, hopefulness, and mental placidity aid us in maintaining the health of the body, we must briefly consider the functions of the mind, and we are in a favourable position to do this satisfactorily, as we have already some acquaintance with the brain and its anatomy and physiology. (See section on "Rest," Chapter V.)

We have previously noted that there is an inseparable connection between the more complex nervous tissues and mental phenomena. We have seen that the

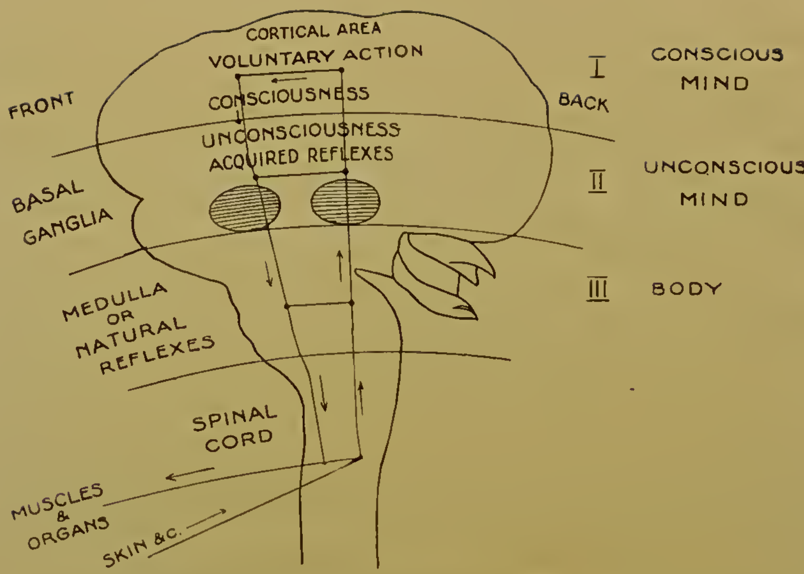
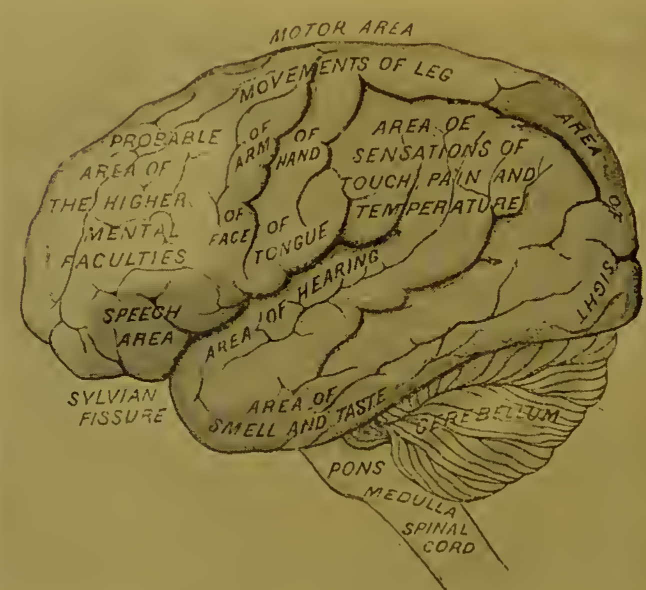


Diagram to illustrate Brain and Nerve Action. (Adapted from *Functional Nerve Diseases.* A. T. SCHOFIELD.)



Reproduced from Ranney's *Lectures on Nervous Diseases.* In the original it is beautifully coloured, and is a diagram designed by Professor Ranney to illustrate the probable functions of different areas of the cerebral cortex.

operation of the mental function produces changes in the brain, although all cerebral changes do not necessarily result in cerebral action, as vasomotor and nutritive changes may take place without producing mentality. Mind is, however, not simply a secretion of the brain. The two are essentially distinct, like the piano and its player. Even Herbert Spencer clearly affirms that there is not the remotest possibility of interpreting mind in terms of matter.

The essential activities of the higher nervous system can be best apprehended from a study of the accompanying rough diagram. From above downwards this diagrammatic representation of the brain is divided into three parts by the horizontal lines.

(1) The uppermost, irregularly convoluted, superficial or cortical area of the brain, in which resides all conscious mental action. It is the seat of consciousness, intellect, and directing intelligence, and, although doubtless many sensations reach it of which we are unconscious, still we now know that we can never become conscious of any stimulus that does not reach the cortex.

(2) The middle region where, beneath the vaulted grey substance of the brain, nestles the basal ganglia, chief among which are those presiding over vision, sensation, and motion. This is the seat of the Vital Principle, together with such mental powers as are possessed by the animals in common with man. This is the region of acquired reflexes and unconscious action, because, although life with all its complexities of movement and sensation, special and general, can be conducted after the removal of all the tissues corresponding to section 1, it is carried on without the consciousness of the individual, and therefore without his consent.

(3) The lowest or medullary region, in which reside

the centres for circulation and respiration. It is the seat of mere physical existence or natural reflexes, because, although without the above two layers life is quite possible, it is a mere vegetative existence without motion or sensation.

Now, we have already seen that all these tissues are composed of cells and fibres embedded in neuroglia and supplicd freely by capillary blood vessels, the cells residing chiefly in the grey matter of the cortical area, and the basal ganglia and the fibres connecting them with every cell and tissue in the body.

Messages or stimuli pass from the cells in the organs or tissues of thc periphery through the posterior part of the spinal cord, and a response is recorded in one of four different ways. (1) The message may not get beyond thc spinal cord, but be shunted across to its front portion and materialise in a reply through the motor centres there; or, (2) it may go higher to the medulla and there be answered; or, (3) still higher to the basal ganglia; or, (4) yet higher to the cortical area. Only in this last will consciousness be brought into action: all the other responses are in the nature of reflexes, as they are called.

"Association of Ideas."

In the region of consciousness, however,—over and above the response to external stimulus,—volition or voluntary action is possible, and this, without the necessity of a message from the outside, may originatc an impulse acting on any of the body tissues.

The method whereby this takes place is really only a matter for conjecture, but it is supposed that each cell contains an idea which must at first havc been rcccivcd from without by a process of training or education. No change is produced in the composition of the cell by its reception, but a rearrangement of its tiny particlcs

occurs, which may only be temporary. If the repetition of the idea be sufficiently frequent or the original impression strong enough, then the idea becomes part of the permanent stock at the command of its possessor, more or less easily capable of being recalled or recollected, as we say. This liability to recollection is increased by the junction of the processes of one cell with one or more neighbouring cells, and this joining of hands reinforces the potential energy and is the physical substratum in the "association of ideas" so well known to psychologists, which is the fundamental basis of all the functions of the brain. Even although this conception is only theoretical, it is convenient to retain it, because it furnishes a working hypothesis for the better understanding of the working of the brain, without the necessity for believing that it is divided into certain compartments labelled the will, the intellect, the judgment, the memory, the reasoning power, and so forth.

It is well known that the functioning of the brain is brought about in the first place by efforts of attention, compelling the cells to focus themselves on the matter in hand, and that this results in the formation of all sorts of habits, practical, emotional, and intellectual, which, although difficult at first, become by repetition almost automatic. The basal ganglia are the centres in the brain which preside over these acquired reflexes or habits, and, reasoning by analogy, they can only become possible in the method above described of junction between the cells and fibres to make a well-worn track or path, much in the same way that continual walking over a green field creates a footpath. The basal ganglia may be brought into action by a stimulus from above, *i.e.* by voluntary action, or from below, *i.e.* by reflex. But behind the voluntary action, if it is to culminate in any-

thing more than a mere animal existence, there must be something else, the " ego " or attention or whatever is the psychic or spiritual entity which differentiates us from all creation. At this point there is a division in the camp, one company of scientists saying that the nervous tissues themselves produce the psychic phenomenon we call mind, and hence called materialists or monists, and another section saying that there is a spiritual entity which acts upon the brain much as a player upon the piano, hence called dualists or vitalists. In my opinion the latter is the only doctrine which can explain the action of the brain, as even the bodily functions of digestion and secretion cannot be explained by a mechanical or material theory alone. It is always necessary to postulate the existence of life or vitality.

The Field of Consciousness.

Now, very much takes place in the mind of which we are absolutely unconscious, the conscious activities indeed being only those to which we give attention. It may be said that our inner life is built up of streams of consciousness, a constant succession of knowledge, sensations, desire, deliberation, continually passing and repassing. We do not know whence these originate, but many think they can only be explained by the hypothesis of a spiritual existence behind the merely material. At any given moment there exists a field of consciousness, built up of combinations of concepts or ideas and emotional states. This field is of a kaleidoscopic nature, but it is always possible to recognise a central idea, called " the focal object," and a whole mass of surrounding ideas, each one of which is called " the marginal object," any one of them being at any moment liable to become " the focal object."

When we talk of " making up our mind " we apply the focal object for the time being to any or all of the

marginal objects in succession, until we find one which so fits it and reinforces it that the problem is for us, and for the moment at least, solved. Now, these fields of consciousness must be composed more or less of groups of associated ideas, the central one of which acts and reacts on each or all of the marginal ones, producing some form of stimulation of more or less intensity according to circumstances. Out of a possible large number only one group is selected to undergo further definite activity when the mind is made up, but it must not be thought that the evanescent effect on the other cells is altogether lost, nor that the effect is confined to the cortical area in which all this process is taking place.

We have seen that there is practically an illimitable supply of cells for the influence to reach, and, as one field of consciousness succeeds another almost unconsciously as it were—certainly without our definite control—there must be a huge surplusage of more or less unconscious influences, such as may arise, for instance, from the mere contiguity of different ideas, even in this the realm of consciousness. The "unconscious mind," in fact, has no rigidly refined location; it involves both the cortical area and (perhaps to a greater extent) the region of the basal ganglia, which exercise many of their functions in an unconscious manner. Schofield has traced an analogy between the mind and the spectrum, with its visible rays of light corresponding to the conscious mind and its upper (chemical) and lower (heat) invisible rays corresponding to the supraconscious and subconscious minds respectively, which together make up the "unconscious mind."

Now, almost all the action of the mind upon the body as a factor in disease or treatment is unconscious,

and most of the influence exerted by a physician on his patient, apart from drugs and other physical therapeutic agencies, is unconscious. We have just almost unwittingly introduced another factor, namely, the influence of mind upon mind, but this will be dealt with later on, whilst at present we shall endeavour to elucidate the difficulties of the influence of the mind over the bodily functions. This influence can be exercised in three well-recognised ways, namely: (1) by the intellect or thought, (2) by the emotions or feelings, (3) by the will or volition, although, as we have already seen, it is not considered necessary to delimit any specific area on the surface of the brain presiding over the special functions in question.

The Physical Effects of Thought.

It is certain that the cells in the cortical area act upon the ganglia below them, and by means of a variation in the nerve and blood supply excite, pervert, or depress the sensory, motor, vasomotor and trophic nerves, and through them cause changes in secretion, muscular contraction, nutrition, and sensation. Practically all but one of the twelve pairs of cranial nerves are devoted to the special functioning of the special senses, but the odd one, the pneumogastric, is of the most profound importance, as it directly supplies the lungs, heart, and stomach, and sends important branches to join hands with the sympathetic, thus controlling in large measure almost all of the internal organs.

For centuries it has been known that the expectation of the action of a remedy often causes us to experience its operation beforehand, and John Hunter more than one hundred years ago used to declare that he was confident he could fix his attention on any part until he had sensation in that part. Herbert Spencer could not think of a slate being rubbed with a dry sponge without there running

through him the same thrill that the action itself produced.

The psychical faculty may play upon the sensory centres in the brain so as to produce certain sensorial phenomena, and may also so affect the brain that impressions on the senses received from the outer world may be modified in various ways. Thus the senses of smell, sight, sound, taste, and touch may all be excited by expectation, fancy, or imagination, and it is needless to cite the innumerable examples on record or familiar in ordinary experience. It is more practical to know that, by directing the thoughts too frequently on the stomach, many phenomena may be induced, notably a sensation of weight which will aggravate or may even originate dyspepsia. The confident assertion that a person subject to epileptic fits will have an attack frequently induces one, and one of my own patients tells me she is afraid to say how long it is since she had an attack, as one almost invariably comes on thereafter.

The action both of the heart and of the respiration is quickened by simply concentrating the mind upon them without any emotion or anxiety whatever. Sydenham relates that when he was studying a book upon a certain disease he felt sure he had suffered from it, and but for the fact that he was changing his subject at frequent intervals, always thinking he had the fresh disease, he is certain he would have succumbed to one or other of them. It is well known that expectation may induce sleep at a certain hour and may cause awakening, and everybody knows the influence of regular habit and expectation on the action of the bowels. The effect of a purgative pill has been rendered inert and sleep induced instead by the belief that an opiate had been administered. A French doctor gave sugared water to

one hundred patients in hospital, and then told them that he had inadvertently given them an emetic instead, with the result that shortly afterwards no fewer than eighty of them were unmistakably sick.

The Physical Effects of Emotion.

But, powerful as the influence of thought is upon the bodily functions, it is quite eclipsed by the effect of the emotions. It is not easy to define the emotional part of our being, although we all know the difference between purely intellectual operations of the mind and that vivid state of feeling or sentiment which is equally distinct from, though generally involving, bodily sensation whether of pleasure or pain. It differs also from the will, although ideas may excite emotions and these form motives followed by acts of volition, so that reflective, emotional, and volitional states are intimately bound together.

Emotions may be elevating and pleasurable, or depressing and painful. Some have located the emotions in the sympathetic and especially the solar plexus, because of the curious epigastric sensation so often felt when under the influence of emotions usually described as "qualms of the stomach," but it is more likely that they originate in the medulla or in some of the basal ganglia.

A stimulus from the brain above on these ganglia produces the emotional state which can and undoubtedly does affect the sensations, and, although central in origin, these are referred by the mind to the peripheral terminations of the nerves involved. That is the reason why, just before delivering a speech or engaging in some important undertaking, those familiar sensations are experienced; they are really excited by the brain, and therefore purely psychical, although they are felt as if they were at the stomach or at the heart. It is doubtless true that there is a flushing of the blood vessels of

the stomach, or in the neighbourhood of the stomach, comparable with the blushing of the face, but the real stimulus is in the brain.

Besides affecting the sensations, emotion has a great influence on the muscles, especially of the face, hands, and respiration; and expression, indeed, depends on contractions and relaxations of the facial muscles. Cheerfulness excites all the muscular system, and in its higher degrees produces laughter, dancing, jumping, and leaping; when moderate, it causes the mouth and the eyes to smile, the upper lips to be raised and the teeth displayed. It brightens the eyes, dilates the nostrils, raises the angles of the mouth, the eyelids and eyebrows, increases the activity of the vocal muscles, giving a peculiar expression to the voice, and in short causes an opening-out and stimulation of all the functions of the body. This is doubtless brought about by an increased supply of blood to all the vital parts, because we know that the heart is accelerated, the temperature slightly raised, the oxygenation of the blood increased, and the action of the skin and kidneys stimulated, so as to hasten the excretion of their poisons.

Depressing emotions like anger and grief produce symptoms which are just the reverse of all this, a constricting, contracting, or shutting-up influence, conveyed doubtless by a diminished blood supply and nervous stimulation to the internal organs. "Care killed the cat" is a common saying, and we know that strong emotion like anger can easily poison the saliva, so that the buccal secretion of an enraged animal is essentially the same as the venom of a viper. We know that fear checks the secretion of the saliva, and the method is employed in India to detect guilty people. The suspects are arranged in a row and given dry rice to chew, when

those who fail to insalivate the mass to a normal extent are quickly singled out. Pleasant emotions increase the flow of gastric juice, and this fact is indicated by the title of "psychic juice" applied to it by Pawlow. The same effect, too, is produced on the bowels, so that constipation is as often due to depressing emotions which inhibit the secretion of the intestinal canal as to any other cause.

The close association between bile and bad temper has passed into the language, and doubtless an atrabilious subject owes his melancholy to a thickening of the secretion of the liver, due to its diminished fluidity. It is a well-known fact that the milk of a nursing woman can be poisoned by a fit of temper, and one case is recorded where during a period of four years a young woman successively lost two children and a foster-child through suckling them immediately after being in a violent passion. Strong mental emotion often causes vomiting, and a sudden fright has produced jaundice, whilst a sudden fit of anger has often caused apoplexy and death. There is inexhaustible evidence to prove that the various mental states, emotions, and passions have their peculiar effects upon the body, and may induce in turn, if indulged in to any great extent, their own peculiar forms of disease, which may become chronic afflictions.

Phenomena of Fear.

Special mention must be made of the effects of fear on the body, as this will serve as an introduction to the consideration of that most prevalent of all obsessions—by some, indeed, considered a disease—which we describe as worry. In its most intense form of terror it is characterised by a husky voice, spasmodic respirations producing breathlessness, and even an actual suspension of breathing for the time being, a shuddering and shrinking,

whilst the stillness of death reigns. When not so severe as to rob the victim of voluntary movement by paralysing the muscles, it induces rapid muscular action in the form of flight, and fixes and contracts other parts of the body in the instinctive attempt to find concealment by diminishing the size. The general effect is that of crouching, caused by the contraction of the flexor muscles, in contradistinction to the effect of courage, which contracts the extensors, producing expansion and height. Trembling, palpitation, and pallor are observed, almost as severe as would be experienced by the actual suffering of the evil feared.

It is capable of producing all sorts of maladies. Indeed, Mosso says that to mention all their names would mean copying nearly the whole index of a pathological text-book. He quotes from Dubois the case of two brothers who were bitten by a mad dog. One had to leave at once for America, and thought no more about it. Twenty years afterwards, when he returned, he heard that his brother had died of hydrophobia, whereupon he immediately fell ill and died with all the symptoms of the same disease. During epidemics fear plays immense havoc, and this is especially noticeable amongst soldiers in a defeated army, who succumb more easily to fevers, and also die more readily of their wounds. A lady who received news of the death of a relative from cholera in a distant country was so frightened that she suffered for eight days from severe diarrhœa, and only recovered after being convinced that there was not a single case of cholera within hundreds of miles.

An infinite variety of ailments are aggravated by fear, and on the other hand many ailments are cured by it. It appears to produce its effects on the system

by diminishing the supply of blood to the cerebral centres, and when one considers that one-fifth part of the blood goes to supply the brain, it is easy to understand the importance of fluctuations in the transmission of blood to this organ.

Worry distinct from Anxiety.

The relationship between fear and worry is very close, and consists in this, that, whilst the former is concerned with some tangible event, the latter responds to a more indefinite source of disturbance, and is indeed simply a long-drawn-out condition of fear.

We have seen that the attention is the driving force of the mind, inasmuch as it links up the various cells and fibres necessary to exact thought and action, but to be practically effective in the affairs of life it must ever seek a goal outside of the individual, and hence its impulse is centrifugal.

Worry, on the other hand, is an excess of uncontrolled attention, causing that driving force to be wasted on the brain cells and fibres, and refusing to allow the escape of the potential force, so that it runs to waste among the machinery, putting it out of gear, causing intense friction, and mayhap breakage of some of its component parts. Some consider that the condition of worry is normal, because it is essential, if one is to be successful at all, that he should pay a great deal of attention to business and duty, but the criterion of excessive attention is that it produces inaction instead of action, and renders the individual less and not more capable of his responsibilities.

It would certainly be better to describe this ordinary everyday mental prevision by some such term as "anxious-mindedness," leaving the word "worry" to signify the morbid introspection which paralyses efforts and eats out life itself like a canker. It is bound to

wear out the brain cells in the long run, and in any case quickly induces in them a condition of fatigue. This result is easily understood when we consider that it springs from an application of the same focal object or central idea to the same marginal objects time after time—these marginal objects being refractory to the victim's habitual train of mental association or to his inadequate energy of mental synthesis.

Thus the futility of worry is revealed in all its scientific harshness, and the analysis reinforces the popular saying that "it is useless to worry." But it is also useless to tell the unfortunate sufferer not to worry, as some more affirmative and positive antidote is required. The only possible way of escape from the trouble is to change the field of consciousness, and, instead of allowing the attention wildly to rush about on the perplexing area like a caged lion, to coax it or compel it to pass over to some other field of consciousness where the focal object or central idea can easily find a selection of marginal objects with which it is usually in the habit of joining hands. By this means the inaction and frustration which is symptomatic of worry is replaced by activity, and so long as the attention is directed to a line of thought which makes for action the loss of valuable energy in worrying is suspended. Worry, indeed, has been replaced by a useful outlet for energy which was hitherto running riot in the most delicate of internal parts, wearing them out, and through them wasting the whole vital forces of the body.

The Ravages of Worry.

It is not easy to give a good concrete illustration of the effects of worry, but the following is one of the best that has occurred to me. Let us imagine a manufactory whose varied machinery is worked by hydraulic

power, represented by a head of water stored in a huge cistern in the top of the building. A variety of pipes closed by stop-cocks emanates from the bottom or sides of the cistern, and all that is necessary to obtain the power required to set the machinery in motion is to connect each of those pipes with its appropriate outlet in the shape of a hose, and turn on the stop-cock. Let us suppose further that in the evening, when work has ceased, the water which has been utilised in moving the various machines is automatically pumped back again to the cistern in the upper storey. We have then established a fairly accurate analogy with the body. If, now, the stop-cock of one of these pipes in the cistern were to be opened without being connected with its corresponding hose-pipe, then not only would the machine worked by that apparatus be unable to move, but the water would escape, causing a gradual diminution of the stored-up energy, and at the same time saturating all the premises with the rapidly escaping fluid, causing probably an immense amount of damage to the whole structure and its contents. In addition to this, however, the energy would be lost for ever, as it could not be collected and returned to the cistern. If, for any reason, the pipe could not be connected with its appropriate hose-pipe, the only way to save the stored-up fluid or energy would be to shut off the stop-cock, or, if this were impossible or premature, to connect it with one of the other hose-pipes, even at the risk of working a different part of the machinery.

The analogy is not perfect, but, I hope, fairly clear and emphatic enough to demonstrate that the only remedy for worry is either to engage the attention sufficiently to enable the victim to go to sleep—when during rest the unconscious mind will usually solve the

difficulty, and in any case will repair the damage wrought to the exhausted brain cells—or else to divert the energy into some other channel where it can be utilised in such a way as to engage the attention fully. If neither of these be done, then it is only a question of time for the condition of the body to become quite as parlous as that of the manufactory just mentioned, because worry acts and reacts on the human system, establishing a vicious circle, first producing insomnia and depression of spirits, then inducing chronic fatigue and neurasthenia, thereafter indigestion and lack of sleep, and so weakening the tissues and organs of the body that they are unable to repair the daily waste, and when this has lasted for a sufficient length of time disease soon makes its appearance. This may be hypochondria, hysteria, nervous debility, or other form of nervous disease, not excepting insanity; it may lead to over-indulgence in drink or other poisons, may even lead to suicide, and in any case, if it goes no further, so lowers the vitality of the body that it is liable to fall an easy prey to infectious disease.

The causes of worry are varied, but in the long run resolve themselves into some form of irritant. The chief desire of the human race is to attain happiness, and the cause of worry will always be found to be something which interferes with this quest. There will generally, however, exist something in the shape of a predisposing cause which is usually some form of poisonous agency, *e.g.* over-indulgence in alcohol, tea, coffee, tobacco, or other toxic substance, and we have already seen that overwork is capable of being included in this category. All of these causes render the tissues less capable of resisting the inroads of any irritant, and liable to respond to a weaker stimulus than during health.

The exciting causes may be divided into physical, mental, and moral, and may be either removable or not. This applies to each of the classes, but it is perhaps most easily comprehensible in the first class, as we can understand the difference between the discomfort attending such a disease as eczema and that associated with cancer,—the hopefulness possible with the one and the hopelessness attached to the other. Mental problems are a fruitful source of worry, not only those arising in business, but also those more obscure and abstruse occurring in metaphysics and theology, many of which are quite insoluble. It is, however, in the moral nature that most of the causes of worry are found to exist, as it is likewise from it that consolation arises when for any reason the cause of worry cannot be removed.

The Physical Effects of Volition.

As the moral nature is so closely bound up with the will, we must now shortly turn our attention to the analysis of the latter and to its influence upon the body. It is perhaps more difficult to define the will than the intellect, and, as we were driven there to advance a concrete though hypothetical explanation of its working, it will suffice here to say that there is no faculty of will inhabiting a specific portion of the brain, but that the same cells with their ideas or thoughts co-operate with some emotional state or feeling, and the desire to do a certain act, which is generated by the feeling, is present. "Will is only the name for the action upon suggestions of conduct, which are so clear in our minds that we are able to deliberate upon them, acting only after some reflection, and so having a sense that the action springs from our own choice." The real sources of action are thoughts or motives or suggestions, without which we cannot act, and which, when present, compel us to act.

It is important to differentiate between the wish or desire to do a certain thing and the power to do it. A man may will to walk, but if the nerves of his legs are cut his will is quite powerless to move his legs. Again, a patient is unable to speak, however much he wills it, if the particular centre in his brain—Broca's convolution—which is used in remembering how the words feel, or sound, be destroyed. In a case of hysterical paralysis, on the other hand, the parts are perfect, but the will, the desire to act, is paralysed. As Sir James Paget used to say, "It is not that such a patient cannot, nor will not; it is that she cannot will." Finally, it is remarkable that in certain patients having partial paralysis it is found that, when their eyes are bandaged, they are unable to use their limbs, because they cannot realise, without seeing the limb, how it would feel to move it. If, however, they see the limb they are able to move it freely, and this shows the dependence of action upon the thought which the mind has at the time, *i.e.* upon the suggestions or motives in the mind.

The influence of the will upon the body is so great as to be capable in some of creating ocular spectra, and in others of feigning an attack of epilepsy with perfect accuracy. Lockjaw and paralysis could by some be equally induced by the power of the will, but the most interesting case of such power was surely that of Colonel Townshend, who was able at will to produce stoppage of his heart's action and thus simulate death. The sequel, it may be mentioned, was that he did this once too often, and death actually took place. Darwin mentions a similar case, and also that of a man who could so far increase the peristaltic action of his bowels by voluntary effort, that he could defæcate at any time in half an hour. Many other instances are on record of those who

could at will dilate or contract the pupils of their eyes, and those who could by an act of will induce vomiting.

Mental Therapeutics.

We are now in a position to appreciate the fact that, as in health certain mental states are capable of producing disease, so in disease they are capable of causing a return to a healthy state. Scattered throughout the literature of medicine many such cases are to be found recorded, but in his classical book on the subject Dr. Hack Tuke has collected for us a large number of the more notable, and I take the liberty of briefly detailing a few of these.

Fear or imagination is well known to exert a wonderful influence over such a painful condition as toothache, as witness its frequent departure at the moment of setting foot on the dentist's doorstep. In Devonshire until quite recently a sufferer from sciatica would be made to lie on his back on the bank of a river with a straight staff by his side between him and the water, and have a form of nonsensical words repeated over him. The frequent and undoubted efficacy of the treatment was due entirely to the imagination. Sir Benjamin Brodie records the case of a young lady who had long laboured under hysterical neuralgia of the hip and thigh, but who immediately lost all her symptoms on being thrown from a donkey on which she was riding.

Every one has heard the story of the doctor who left his prescription on the table for a lady who suffered from neuralgia of the pleura, saying, "Put this on your side," and how the patient literally did so instead of obtaining the prescribed plaster, and in the event was cured. A case of epilepsy of four years' duration was cured on the patient receiving a dreadful mental shock from the circumstance of her daughter being accidentally burned to death. Fear used to be a popular remedy in the

treatment of whooping-cough, just as in some towns to-day it is quite a common occurrence to find the victims of that malady taken for a walk round the local gasworks, and a case is recorded of a child who was cured by a good thrashing. A woman whose hand by reason of hysterics had been for thirty-eight years closed as firmly as the fist of a boxer, and could only be opened by considerable force, was opened and remained cured on the emotional appeal of a Madame de St. Amour.

Paralysis of the limbs has been cured by the terror aroused by a thunderstorm, and Sir Humphry Davy's unparalleled cure of that condition was due to aroused hope and expectation. He placed a thermometer under the tongue simply to ascertain the temperature, but, as the patient avowed he was better thereafter, having mistaken the manœuvre for a new treatment about to be tried, the fictitious treatment was kept up for a fortnight once a day, when the cure was consummated.

Imagination may act as a purgative, as illustrated in the recorded case of a young woman. Having to take a purge on the following day, in the form of a medicament she specially disliked, she dreamed that she had taken the bitter dose, and, griped by the imaginary remedy, she awoke and her bowels acted freely five or six times. During some military operations in India an officer who was confined to bed with asthma, and could breathe only in the erect posture, sprang out of his bed on an alarm and used his sword with such execution as not only to impel the marauders but also to dispel the asthma. Dr. Rush mentions the case of a captain of a British man-of-war confined to bed by a severe attack of gout in his feet, who was suddenly cured by hearing the cry of "Fire" aboard his ship, and, strange to relate, never had a recurrence of his malady. Among the remedies

for drunkenness, emotional excitement is not the least peculiar. Dr. Witherspoon tells of a man in Scotland who was always cured of a fit of drunkenness by being made angry, by a tirade, not against drunkenness but against religion.

But it would only weary the reader to go on detailing the cases of diseases cured by the exercise of imagination, expectation, hope, fear, joy, and faith. The fact is unquestionable, and it now remains to inquire how this verified power can be practically utilised for purposes of therapeutic application.

Moral Influence in Medicine.

Who will gainsay the fact that the confidence reposed by a patient in the bottle of medicine is often the sole factor in the amelioration of his disease? Dr. Rush says he has often prescribed remedies of doubtful efficacy in the initial stage of acute diseases, but never till he had worked his patient into a confidence bordering upon certainty of their good effects. A French physician for long treated his cases with nothing more serious than bread pills covered with silver paper and contained in a box with the prominent label "Purgatives," with the profoundly satisfactory results of curing their constipation, and this experience has been repeated too often for the results to be questioned. Good results in the treatment of disease have been obtained by the fantastic process of directing the attention to the part affected, and then by means of a pair of wooden or metal tractors drawn over the skin extracting the pain or ailment. Cases of hydrophobia and other equally serious diseases have been cured by the exercise of the will in a fashion recalling the words of the poet Churchill—

> "The surest road to health, say what you will,
> Is never to suppose we shall be ill,
> Most of those evils, we poor mortals know,
> From doctors and imagination flow."

As a reservation to the last couplet, it should be said that in many cases the doctor's presence is the only therapeutic factor of moment, and evidence is daily accumulating that hopefulness and cheerfulness communicated to the patient are among the most wonderful of remedial agencies.

The renewal of the bodily tissues is a process which has been held to occupy various periods, extending from seven years to a much shorter duration of time. In any case its existence helps to a comprehension of the fact that the healing power of nature can be reinforced by the confidence generated by cheerfulness. For what is this *vis medicatrix naturæ* but the life principle itself, which exercises its beneficent power of nutrition through the medium of the nervous system ? Now, it is a well-known fact that the blood vessels of the cortex of the brain are flushed and dilated by the presence of cheerfulness, and the toning and stimulating influence is conveyed by the life-giving blood and nerve-current to every tissue of the body, literally re-creating them, and the continuous reconstruction of the tissues must obviously exercise a notable effect upon a patient's progress.

The Value of Cheerfulness.

Medicines and other therapeutic remedies are of value in removing obstructions to the flow of the blood and nerve currents, but contain no curative properties within themselves. They help to remove the effects of violations of the laws of health, but when these have been cleared out of the way and the body again brought into harmonious relations with its environment, fortified by a calm and quiet expectant mental attitude, healing is as sure to take place as it is that snow will melt in sunshine. If, however, we are dominated by fear or lack of faith and confidence, our nervous centres are depleted of their blood and we are apt to realise the very contingency

we fear. Evil passions like anger, jealousy, lust, malice, continual fault-finding and grumbling are predisposed to exercise the same malign influence over the body.

The power of the mental factor in the building and rebuilding of the body is most subtle and profound. "Make yourselves nests of pleasant thoughts," says Ruskin; "none of us as yet know, for none of us have been taught in early youth, what fairy palaces we may build of beautiful thoughts, proof against all adversity." The time has come when the true physician must pay more attention to the healing of the mind, not instead of, but in addition to healing the body, knowing full well that the mind will in turn do its share in healing the body. His work, indeed, ought to be to keep people well rather than attempting to make them well after disease and sickness have done their work. He must teach his patients to cultivate cheerfulness, goodwill, and service for others, knowing full well that the first will be the best health tonic, just as the last two are the best heart tonics.

The true way of attaining personal happiness is by reaching forth a helping hand to make others happy. It can never be found by searching for it either in the outside world or in ourselves, but it lies at the hand of him who reaches it forth to assist his fellows. Too much attention paid to our own bodies is not always productive of good health, but often the contrary. If we think about our health at all, on its unfavourable side, we should never brood upon our ailments or analyse their symptoms. The soundest course is by constant practice to cultivate a strong will power and valiantly fight against the ills of life, remembering that our thoughts and imaginations are the only real limits to our possibilities. As a rule we raise our own mountains of

difficulty, and no man's success or health is likely to reach beyond his own confidence. Be an optimist and not a pessimist, and as all young men have a tendency to the latter frame of mind, the earlier one starts on the better course the greater success will be attained. Not that it is wise to be over-anxious about our success any more than about our health, as such savours of worry and usually frustrates the end in view. The existence of Health Clubs and Success Clubs, even when perfectly genuine, savours too much of self-consciousness, a frame of mind most uncongenial to good results in either direction, and more than likely to lead to neglect of the conditions necessary to the desired end.

It is said that thoughts are forces, and from the Western Continent comes the statement that in the laboratory they are being subjected to physical tests and found to have form, quality, substance, and power. They are said to emanate from us like waves and influence those with whom they come in contact either for good or evil, consciously or unconsciously, and that something of the kind occurs is perfectly evident when we consider the probable explanation of telepathy. The unfortunate possessor of a hypersensitive or supernormally developed nervous system is unquestionably influenced by the mental and physical condition of those with whom he comes into contact, and this may often be the cause of disease. There is some evidence to show that we attract to ourselves influences and conditions most akin to those of our own thoughts and lives. Those who live in an atmosphere of gloom attract to them gloomy things, those always discouraged and despondent never succeed in anything and only burden the lives of others. The hopeful, the confident, the cheerful are the recipients of success. Never pay a man back in his own coin of the

moral mint, but return good for evil. You will be more hurt than hurting if you try the opposite way. The psychology of the Sermon on the Mount, reversing as it did the old method of retaliation, will be found to answer all the requirements of health of body and mind.

The Principle of "Suggestion."

Recognising, therefore, the stupendous power for good or evil which the mind exerts over the body, we need not be surprised that an effort has been made to enrol it in the systematic resources of medical skill, and, as has been already said, it is being used daily in an unconscious manner by the successful physician everywhere. In some cases, indeed, it is the only treatment which is necessary, and this applies, of course, to disease of psychic origin.

The term "suggestion" has been employed for this potent remedy whether utilised by the physician in a conscious or unconscious manner or exercised by the patient himself. There is no doubt that between a medical man and a patient who is said to have confidence in him there is a constant interchange of psychic or moral force and response. A suggestion may be described as an influence from the environment, either physical or personal, which obtains a lodgment in the consciousness and leads to action; and, as employed in therapeutics, it is usually an encouraging idea emanating from the physician, either directly or indirectly. It is not persuasion, or rational explanation, but appeals to the unconscious mind, although it works through the consciousness. It is of the greatest potency in the strong-minded, and least capable of use against the weak-minded. It is being employed every day in the most subtle way in our newspaper advertisements, and especially in the descriptions commercially applied to articles of food and drink.

When recognised as a suggestion, it is apt to lose value, and hence its too frequent repetition is often self-stultifying. When used as a medium for treatment between physician and patient, certain conditions are necessary for success, such as earnestness on the doctor's part, with monotonous repetition of the same idea, the careful avoidance of any foreign idea, a quiet impressive reposeful manner, and, as far as possible, some implication of immediate execution of the idea suggested. To explain its action we must revert to our hypothetical working example of mental functioning.

In every field of consciousness there are many inhibitory as well as co-operative marginal objects, and suggestion acts by fixing of the attention on one particular focal object and quickly and firmly linking it up with as many co-operative marginal objects as possible. If the idea be translated into an action by passing it on to the basal ganglia, then the links are more firmly bound together and a stronger chain is forced. Once get the helpful suggestion by this means out of the region of conscious thought, and therefore away from the restraint of inhibitory or opposing concepts, and the unconscious mind will keep on exerting its influence in the positive direction.

Suggestion is, of course, capable of acting for evil as well as for good, and this is particularly true of auto-suggestion or subjective suggestion. It is, in fact, to correct the bad impressions, the doleful anticipations of evil on the part of the patient, that the hopeful, helpful suggestions on the part of the physician are of such great value. To translate the helpful suggestion into action at once, *i.e.* to enlist the basal ganglia in its favour in the unconscious mind, is really to effect inhibition by means of substitution, and this, it will easily be under-

stood, is a more efficacious process than inhibition by repression or negation. The latter is rarely, if ever, successful, whereas the former is highly potential, as we have seen in the case of worry.

We have seen that by an expectant attitude of mind it is possible to arouse ourselves at some definite time in the morning, and we may go further and say that by willing certain things before falling asleep, their performance is frequently assured after waking in the morning. There is much truth in this assertion, as many people can prove for themselves; but the result, whilst undoubtedly due to suggestion, has something in common with another mental condition, namely, hypnotism, and to this we must now shortly direct our attention.

Hypnotism.

Hypnotism is a state of abnormal consciousness produced by suggestion, which may proceed from a hypnotist, a sensation or an idea. When by any cause the attention is directed upon a bright object, such as a crystal or a button for a sufficient length of time without distraction, the patient begins to lose consciousness in a curious manner. This loss of consciousness is of three degrees, and may amount to (1) a light sleep, or (2) a deep sleep, or (3) somnambulism; this last being the condition developed in *bona fide* mesmeric exhibitions.

In each of these states, curative suggestions can be made. In the first the subject may be perfectly able to open his eyes, although told he cannot do so; in the second, he has lost the power of moving, but he can remember everything that has been said; in the third, which need not result in actual walking about but only be characterised by a deep lethargy, there is complete loss of consciousness. This is the condition most favourable for inducing healing effects, and in it the following characteristics are noted:—

(1) A peculiar state of memory. In the hypnotic condition all the ordinary affairs of life are forgotten, and after waking the events of the hypnotic state are forgotten. When, however, hypnosis is again induced, recollection of the previous hypnotic state takes place. Thus there are two memories, one for the normal condition and one for the hypnotic condition.

(2) Capacity for receiving and acting upon suggestions. The subject will think, say, and do anything he may be told, and even pain or pleasure may be produced at command. The skin may be actually scarred with a lead pencil, if the subject be told it is a red hot iron. Most remarkable of all, however, the suggestions received during this state may not be acted upon till long after waking, if the operator has commanded them to be deferred till this time. This is called post-hypnotic suggestion.

(3) The senses and mental faculties are intensely exalted, so that hearing, vision, touch, memory are rendered much more acute. For this reason the patient may receive suggestions not actually intended by the operator.

(4) A condition is established known as "Rapport" whereby the subject remains completely under the control of the operator and is open to suggestions received from him alone. Not only is this the case, but frequently the patient is insusceptible to hypnotism by other than one particular person, who has thus immense influence over him, though, strange to say, during the unconscious condition the hypnotist can transfer this power to a third party.

There is no specific method of producing hypnosis, but the result is much more rapid and intense in proportion to the firmness of the impression that it is going

to succeed. The most usual method is that involving a sensory impression with a fatigue effort, and thus the gazing at a glass ball, a metal button or revolving mirror, held about 12 or 18 inches from the eyes in such a position that a strain is produced in keeping it in sight, is one of the best in vogue. But many other mystifying and elaborate performances are often practised, such as incantations, rubbings, passes, all of which are quite needless, although they may serve to work in the way of suggestion upon the mind of the subject.

It is well known that men are much more inclined to fall asleep in church than women, and the explanation has been advanced that this is due to their closer attention to the preacher, being hypnotised by the steady staring in a monotonous position at the pulpit. Women, on the other hand, are less concentrated in their attention and more conscious of the distractions of their environment.

Most people in ordinary health can hypnotise and be hypnotised, but weak-minded people and idiots are unable to be influenced, being incapable of fixing their attention with sufficient force or continuity. Auto-suggestion, already mentioned, is simply self-hypnotisation. There is no difficulty in awaking a patient from the hypnotic state. Needless to say, the process should not be practised upon any one without the most careful consideration, and especially should not be frequently resorted to in the same subject. It should, indeed, be left entirely in the hands of medical men who are themselves sufficiently expert in its practice. It is well known that criminal suggestions can be made during the hypnotic state, and crimes for which this explanation suggests itself are periodically brought to public notice.

Other Aspects of "Suggestion."

Many remarkable and sensational cases of the cure of disease by hypnotic suggestion are constantly being reported, but in this country it has not gained much recognition from medical men as an agent of great therapeutic value. It is used chiefly in insomnia, drunkenness, pains of a neuralgic or rheumatic character and those usually of a functional nature, although Braid, who is responsible for attracting the attention of the medical profession in this country to the subject, has reported cases of organic disease cured by the method. The treatment is not without its evils and its dangers, and it is an undoubted fact that it often produces an aggravation of the malady it was meant to alleviate.

The explanation of its good effects is simple enough to the reader who has followed with intelligence the statements made in this chapter. The hypnotic state may shortly be defined as an artificial trance in which the unconscious mind can be easily reached. The lower ranges of the nervous system are communicated with, so to speak, not by the front door of the cortical region but through a postern gate. The upper cortical area of consciousness, in which of course reside all the possibilities of inhibition, is shut off by the induced sleep, and the ideas suggested are then able to filter through without hindrance to the field of action in the basal ganglia, and so the unconscious mind acts without the customary intellectual supervision. The method must on no account be confused with mesmerism or personal magnetism, because no entity passes from the operator to the subject,—there is no actual transference of anything tangible or physical, at least nothing that can be measured by our present methods of estimation, and this is what is claimed by the advocates of mesmerism. There is a vast array of other methods with loud-

sounding and mysterious names, purposely used to mystify the public and which are practised for gain by all sorts of designing, or it may be well-intentioned people, with the view of healing disease; but whatever of value is contained in any of these systems must be without hesitation referred to the beneficent action of suggestion, either on the part of the patient where his consciousness is intact, or on the part of the physician when the consciousness is extinguished or less alert.

Enough has probably been said to show the great and marvellous influence which the mind has on the body, and how by the exercise of the imagination and faith the most astounding results may be procured, although there are, of course, limitations to their beneficial influence. These limitations have been abundantly demonstrated more particularly in Christian Science and Emmanuelism—the latest phases of psychic therapy (or treatment). Little more remains to be said, except perhaps to draw attention to the fact that direct suggestion is as a rule not nearly so potent a factor in the healing of the body as indirect suggestion, and this applies with greater force to the more cultured and educated classes whose critical instincts are more readily aroused by obvious attempts to influence their judgment or conduct.

Nevertheless, as has been pointed out chiefly by laymen and non-professional seekers after health, there is a possibility that the limitation of nature may be carried to great lengths in this connection with undeniable advantage. We have seen, for example, that each emotion has its own particular expression produced by the contractions and relaxations of certain facial muscles, and it remains to be said that the perpetuation or artificial production of such a physiognomic action,

at any rate during a period of depression, is followed by a deepening of the emotional state, recognised in the axiom that "Expression deepens emotion." As a natural consequence, a condition of despair would only be intensified and prolonged by persisting in gloomy countenance, whereas it may be alleviated by overmastering the expression. However, this is not all the truth, because it can easily be demonstrated that, if we will but adopt the physiognomic features of joy and cheerfulness, it is impossible to escape the consequent feeling of joy, as any one can prove for himself if he will but go to his mirror in his next fit of the "blues" and start to smile. Seconds will hardly have elapsed ere he is compelled to feel his smile, and it will not be at all surprising should he at last burst forth into uncontrollable laughter—surely a much more desirable state, whatever the condition of his affairs, than that of despair and dejection. From the bodily point of view there is not so much wrong with the institution of smiling clubs, which we have heard are in existence. May their membership increase, and long may they "Laugh and grow fat." An equally valuable concrete method of obtaining the beneficial physical advantages of cheerfulness is to tell a funny story at the dinner-table, if possible, every day. It is a sovereign remedy for dyspepsia, even should it only be carrying out the injunction to "Assume a virtue if we have it not." Whatever method encourages cheerfulness in the life of the individual deserves to be fostered, and this is doubtless the real reason why, to-day, attendance at the theatres, music halls, and concerts is not looked upon in the deprecatory fashion obtaining only a few years ago.

Auto-Suggestion and Self-Control.

In conclusion, I would desire to say that if any one cares to practise the method of self-hypnotisation or

auto-suggestion, by the process of trusting to ordinary sleep, he may possibly obtain surprising results. It is only necessary calmly and confidently to affirm a certain resolution during that period just before sleep overwhelms him, and when consciousness is gradually waning into somnolence, and in subsequent waking hours he may be astonished to find how often it is realised. There is probably nothing very novel about this except the conscious affirmation of the intention, because all of us doubtless quietly and calmly think over the affairs of the day that has passed, and adumbrate the probable course of action on the ensuing day. It is doubtless the training of the attention which is the explanation of the remarkable results obtained.

For those who are averse from the consolation of religious faith which, being the best example of inhibition by substitution, is unquestionably the sovereign remedy for worry, the study of philosophy is best calculated to produce that mental atmosphere which is unfavourable to friction and worry. The newer and more practical psychology, as taught by Professor William James, of Harvard, may be recommended, and in closing this chapter I take the liberty of extracting wholesale a paragraph from his lecture on "The Gospel of Relaxation."

"There is no better known or more generally useful precept in the moral training of youth, or in one's personal self-discipline, than that which bids us pay primary attention to what we do and express, and not to care too much for what we feel. If we only check a cowardly impulse in time, for example, or if we only do not strike the blow or rip out with the complaining or insulting word that we shall regret as long as we live, our feelings themselves will presently be the calmer and better, with no particular guidance from us on their

account. Action seems to follow feeling, but really action and feeling go together, and by regulating the action, which is under the more direct control of the will, we can indirectly regulate the feeling which is not.

"Thus the sovereign voluntary path to cheerfulness, if our spontaneous cheerfulness be lost, is to sit up cheerfully, to look round cheerfully, and to act and speak as if cheerfulness were already there. If such conduct does not make you soon feel cheerful, nothing else on that occasion can. So, to feel brave, act as if we were brave, use all your will to that end, and a courage fit will very likely replace the fit of fear. Again, in order to feel kindly toward a person to whom we have been inimical, the only way is more or less deliberately to smile, to make sympathetic inquiries, and to force ourselves to say genial things. One hearty laugh together will bring enemies into a closer communion of hearts than hours spent on both sides in inward wrestling with the mental demon of uncharitable feeling. To wrestle with a bad feeling only pins our attention on it, and keeps it still fastened in the mind, whereas, if we act as if from some better feeling, the old bad feeling soon folds its tent like an Arab, and silently steals away."

Practical Summary.

1. Cheerfulness, hopefulness of mind, and placidity of temper can be cultivated by practice.

2. The influence of the mind on the body is of immeasurable value, not only in disease, but also in health.

3. The expectation of the action of medicines and other remedial agencies has much to do with the desired result.

4. Emotions are either elevating or depressing; the former having a beneficial, and the latter a deleterious effect on the bodily functions.

5. Fear alone may occasion suffering quite as great as the realisation of the evil which is feared.

6. Worry is allied to fear, and should be distinguished from anxious-mindedness—a laudable emotion, which only degenerates into worry when it paralyses effort.

7. The cure for worry is action, *i.e.*, compel the attention to become absorbed in some other channel.

8. The will has a mighty effect on the bodily functions for good as well as for evil.

9. Evil passions, like anger, jealousy, envy, lust, etc., poison the secretions and exert a malign influence on the body.

10. The exercise of love and faith is positively hygienic.

11. Good thoughts are of immense value to their possessors, and as thoughts are said to be forces they may possibly influence our neighbours for good.

12. "Suggestion" is an example of the influence of the mind over the body, and is a most potent factor in the amelioration of disease, whether wielded by the individual himself or by an outsider.

13. Hypnotism is a state of abnormal consciousness produced by suggestion, and favourable for the development of healing effects. It is, however, not without its dangers, and should rarely be practised by the physician, and never by the public.

14. "Expression deepens emotion," and the repression of expression helps to control the emotions.

15. If a person be depressed, it is wise to assume the physiognomy of joy or cheerfulness, so that the latter emotion may be encouraged to appear. Telling a funny

story at meal-times is a valuable method of raising the spirits.

16. To develop good habits, practise self-hypnotisation or auto-suggestion in the few minutes immediately preceding sleep. This is a valuable method of training the character.

17. Religious faith, as being the best example of inhibition by substitution, is, after all, the best cure for worry.

INDEX

Printed by
Morrison & Gibb Limited
Edinburgh